SITE ASSESSMENT

6/11/90 - 4/12/9

EPA SITE ASSESSMENT REPORT Request

NAME	ADDRESS
Vincent F. Tong	P.O. Box 14000 Grand Jct, Colo
Chem Nuclear Geotech, Inc	81502
Walter R Mills BIA	Navajo Area Office P.O. Box 1060 Gallup, NM. 87305
THOMAS O'HARE	WINDOW ROCK FIELD (SOLICITOR) OFFICE P.O. BOX M WINDOW ROCK, AZ. 86515
Patty McLean	BLM - Albuquerque Montano Rd Albq NM 87109
James Olsen	BLM - Santa Fe NM-94 Bx 1449 Santa Fe NM
Gil Lockwood	" " " "
Wilfred G. Bowman	BIA Eastern Navajo P.O Box 328 Crownpoint, NM 87313
Joanne A. Manygoats	Navajo Superfund Prog / EPA Bx 2946 WR, Az 86515
Bernard Freeman	OSM, 625 Silver Ave SW ABQ NM 87102

FAX TRANSMISSION

To	Name: Mr Tim Leftwich		
	Organization: Santa Fe Pacific Minerals		
	Mail Stop:		
	FAX No.:	Area Code 505	Number 880 - 5435
	Verification No.:	Area Code	Number

From	Name: William J. Weis III		
	U.S. Environmental Protection Region 9, Field Operations 75 Hawthorne Street San Francisco, California 94105		
	Division / Branch (mail stop): H-8-3 (ERS, FOB, SUPERFUND)		
	Phone No.:	Area Code 415	Number 744 - 2297
	Fax No.:	Area Code 415	Number 744 - 1916 FTS 484 - 1916

Pages	(Including cover) 20
Subject	Preliminary Assessment Data
Note	

- STANFORD: Clif Davis   John Rosen

- MODESTO: NOTICE / No Permits Renewed Cert.   PRESS RELEASE:

- PORT OF L.A. 10,049
  7,487
  5,025
  22,551
  ~~AP Renewals~~ 1,260
  23,811

  37 55 185 185/5 203
  203 874 41 142 1260

- NORCO: FINANCIAL INFO / REDACTING > Peter Creel DID NOT RETURN. 1 DOC. P.O.

- BLUE WATER: FEDERAL MINES (400,000) NO PD COSTS

- NAVAJO FUNDED PRODUCT: BOB, PAUL LOCKE, MYSELF, WILMA. } ORDER: MEMO:

ORDERS: Renewal Order Work Groups:

- J: Drive: ON ORC, R9 ORC

TRAINING: PRR Search. CHECKLIST.

Barbara Rec'd 6/25/90
6/25
→ 6H-MA

THE NAVAJO NATION

LEONARD HASKIE
INTERIM PRESIDENT
NAVAJO NATION

IRVING BILLY
INTERIM VICE PRESIDENT
NAVAJO NATION

NAVAJO SUPERFUND OFFICE
JUN 18 1990

June 11,1990

Mr. Mark Satterwhite
Indian Superfund Coordinator
US-EPA,Region-VI
1445 Ross Avenue
Dallas, Texas 75202-2733

Dear Mr. Satterwhite:

Find enclosed Addenda to the Preliminary Assessment Package for the Navajo-Brown Vandever Uranium Mine.

Additional information, pertinent to the site and Bioaccumulation of Radiospecies has become available(Reference#37). More reliable calculations regarding the area Radon burden have been produced(mine spoils calculations Addenda). Dr. Gaurav Rajen(Senior Environmental Engineer) and Patrick Molloy worked on the calculations. References#35 and #36 are included in support of the calculations. Reference#38 pertains to Radon levels obtained during an Indian Health Service Radon survey in the area of residences approximately two miles from the site. It is intended that the levels be considered as background parameters for the area.

If you have any questions regarding this material, please contact me, Dr. Rajen or Patrick Molloy at (602) 871-7329 or -7332. Thank you.

Sincerely,
Gaurav Rajen, for Clara Bia
Clara Bia
Executive Director
Navajo Superfund Office

Enclosures

CB/pm

NAVAJO - BROWN VANDEVER URANIUM
MINE SPOILS CALCULATIONS ADDENDA
(PLEASE ATTACH TO REFERENCE # 4)

NAVAJO SUPERFUND OFFICE

NAVAJO - BROWN VAN-
DEVER URANIUM MINE

JUNE, '90 P. MOLLOY

NOTES ADDED IN PROOFS FOR THE NAVAJO - BROWN VANDEVER URANIUM MINE PRELIMINARY ASSESSMENT

1. FROM REFERENCE # 35, THE SOLUTION FOR THE ONE - DIMENSIONAL, STEADY - STATE RADON DIFFUSION EQUATION (EQ.(1)) IS;

$$J_t = 10^4 R p E(\lambda D_t)^{\frac{1}{2}} \tanh[(\lambda D_t^{-1})^{\frac{1}{2}} x_t]$$

WHERE

J_t - THE RADON FLUX FROM TAILINGS SURFACE IN $pCi.m^{-2}s^{-1}$

AND

x_t - THICKNESS OF TAILINGS IN cm.

2. REASONABLE VALUES FOR THE PARAMETERS ARE ASSUMED AND ARE;

$p = 1.5\ gm.cm^{-3}$ (DRY BULK DENSITY OF TAILINGS)
$E = 0.23$ (RADON EMANATION COEFFICIENT, DIMENSIONLESS, FROM FIGURE 15, PAGE 5 - 2)
$D_t = 1.3(10^{-2})\ cm^2.s^{-1}$ (DIFFUSION COEFFICIENT FOR RADON IN THE TOTAL PORE SPACE)
$R = K_a G = (.19)(2812\ pCi)$ (SEE PAGE 5-1)
$= 534.28\ pCi$

AND

$\lambda = 2.1(10^{-6})s^{-1}$ (DECAY CONSTANT OF RADON)

3. FURTHER ASSUME THAT THE TAILINGS EQUILIBRIUM MOISTURE CONTENT(DRY WT.%) IS;

$M = 11.7\%$

(FROM FIGURE 15): THIS VALUE YIELDS A RADON EMANATION COEFFICIENT CONSISTENT WITH THE VALUE 0.23.

4. COMPUTE THE RADON FLUX:

$$J_t = 10^4(534.28)(1.5)(0.23)[(2.1(10^{-6})(1.3(10^{-2})]^{\frac{1}{2}} \times \tanh[(2.1(10^{-6})(1.3(10^{-2})^{-1}]^{\frac{1}{2}}(300)$$
$$= 304.26\ pCi.m^{-2}.s^{-1}$$

5. FROM 6. AND 7. OF REFERENCE#4 OF THE PRELIMINARY ASSESSMENT, ASSUME THAT APPROXIMATELY 30% OF THE 251 ACRES IS COVERED WITH TAILINGS TO A DEPTH OF 3m(300 cm) WHEREBY

$$A_t = (0.3)[1.1(10^7)ft^2]$$
$$= 9.34(10^4)\ m^2$$

6. COMPUTE THE TOTAL FLUX

$$J_t A_t = 2.84(10^7)\ pCi.s^{-1}$$

NAVAJO SUPERFUND OFFICE

BROWN VANDEVER URANIUM MINE REFERENCE MATERIAL

MAY, '90 P. MOLLOY

7. COMPUTE THE TOTAL YEARLY RADON PRODUCTION (IN CURIES)}

$$P_{Rn} = (60)^2(24)(365)J_tA_t$$
$$= 8.97(10^{14})(10^{-12})Ci$$
$$= 897 \text{ Curies}$$

8. FROM REFERENCE #2, PAGE #43 THE VALUE FOR THE AVERAGE SPECIFIC FLUX FROM <u>AGED</u> TAILINGS PILES IS}

$$J_t' = (0.19)(10^3) = 190 \text{ pCi.m}^{-2}\text{s}^{-1}$$

WHERE 0.19% IS THE B. VANDEVER ORE GRADE VALUE.

9. THE ALTERNATE TOTAL FLUX FOR THE ASSUMED 75.3 ACRES IS}

$$J_t'A_t = (190)[9.34(10^4)] \text{ pCi.s}^{-1}$$
$$= 1.78(10^7) \text{ pCi.s}^{-1}$$

10. COMPUTE THE TOTAL YEARLY RADON PRODUCTION GIVEN THE ABOVE FLUX}

$$P_{Rn} = (60)^2(24)(365)$$
$$= 560 \text{ Curies}$$

11. THE VALUE FROM REFERENCE #2 FOR <u>TAILINGS</u> PILES IS}

$$J_t'' = (0.19)[3.3(10^3)] \text{ pCi.s}^{-1}$$
$$= 5.87(10^7) \text{ pCi.s}^{-1}$$

12. THE TOTAL YEARLY RADON PRODUCTION FOR A WORST CASE SCENARIO IS THEN}

$$P_{Rn} = (60)^2(24)(365)[5.87(10^7)] \text{ pCi}$$
$$= 1850 \text{ Ci}$$

REFERENCE # 35

NAVAJO SUPERFUND OFFICE

BROWN VANDEVER URANIUM MINE REFERENCE MATERIAL

MAY, '90 P. MOLLOY

REFERENCE # 36

NAVAJO SUPERFUND OFFICE

BROWN VANDEVER URANIUM MINE REFERENCE MATERIAL

MAY, '90 P. MOLLOY

NUREG/CR-3533
PNL-4878
RAE-18-5

Radon Attenuation Handbook for Uranium Mill Tailings Cover Design

Prepared by V. C. Rogers, K. K. Nielson, RAE
D. R. Kalkwarf/PNL

Rogers & Associates Engineering Corporation

Pacific Northwest Laboratory

Prepared for
U.S. Nuclear Regulatory
Commission

2. DETERMINING RADON ATTENUATION THROUGH COVER MATERIALS

The thickness of cover material required for uranium-mill tailings reclamation is usually determined by a radon flux or concentration criterion which must be satisfied. The general approach used in estimating the required thickness of a cover can be divided into two phases. First, the characteristic parameters of the tailings and cover must be measured or estimated. These include the radon diffusion coefficients, porosities and moistures of the tailings and cover, and the radium content and emanating power of the tailings. Second the thickness of cover needed to achieve a prescribed radon flux is determined by iteratively calculating radon fluxes for various cover thicknesses until the thickness giving the prescribed flux is found. Alternatively, an approximate expression can be used to calculate the cover thickness directly.

In the following equations and throughout this handbook, the diffusion coefficient for radon in the total pore space of the soil is designated by the symbol D, consistent with recent reports on radon movement. A second parameter, the effective bulk diffusion coefficient of the soil, is often designated D_e, and has sometimes been confused with D due to varying symbols and nomenclature used in the literature. The two are related by $D = D_e/p$, where p is the total soil porosity. Identical nomenclature but different symbols were used in the earlier handbook(1) and in the NRC's Generic Environmental Impact Statement on Uranium Milling (Appendix P). The symbol D in those reports corresponds to D_e in this handbook.

2.1 RADON DIFFUSION EQUATION

The one-dimensional steady-state radon diffusion equation is:

$$D \frac{d^2C}{dx^2} - \lambda C + R\rho\lambda E/p = 0 \,, \qquad (1)$$

where

C = radon concentration in the total pore space (pCi cm^{-3})

D = diffusion coefficient for radon in the total pore space ($cm^2 s^{-1}$)

λ = decay constant of radon ($2.1 \times 10^{-6}\ s^{-1}$)

R = specific activity of radium in the soil (pCi g^{-1})

ρ = dry bulk density of the soil (g cm^{-3})

E = radon emanation coefficient (dimensionless)

p = total porosity of the soil (dimensionless)

The radon flux from the bulk soil material is related to the radon concentration in its pore space by Fick's Law:

$$J = -10^4 \, Dp \, \frac{dC}{dx} \, , \qquad (2)$$

where

J = bulk radon flux (pCi m^{-2} s^{-1})

10^4 = factor to convert units from pCi $cm^{-2}s^{-1}$ to pCi $m^{-2}s^{-1}$

Appendix A contains the mathematical basis for Equation 1 as well as for the solutions used in this handbook. The solutions of interest are for bare tailings, tailings covered with homogeneous material, and a generalized multiregion problem with many tailings and cover layers.

2.2 FLUX FROM BARE TAILINGS

The solution of Equations 1 and 2 for the flux from a bare, homogeneous tailings pile is:

$$J_t = 10^4 \, R\rho E\sqrt{\lambda D_t} \, \tanh\sqrt{\frac{\lambda}{D_t}} \, x_t \quad , \qquad (3)$$

where

J_t = radon flux from the tailings surface (pCi $m^{-2}s^{-1}$)

x_t = thickness of tailings (cm)

The subscript "t" refers to the tailings region. A graph of $J_t/R\,E$ is given in Figure 2 as a function of x_t, illustrating the limitation on the radon flux imposed by radon decay, particularly for low diffusion coefficients. As illustrated, most of the radon comes from the surface layers of tailings; hence there is an advantage in consolidating tailings into smaller, thicker piles.

2.3 FLUX FROM COVERED TAILINGS

The exact solution from diffusion theory to the two-region, tailings-cover problem is:

$$J_c = \frac{2J_t \, e^{-b_c x_c}}{\left[1 + \sqrt{a_t/a_c} \, \tanh(b_t x_t)\right] + \left[1 - \sqrt{a_t/a_c} \, \tanh(b_t x_t)\right] e^{-2b_c x_c}} \qquad (4)$$

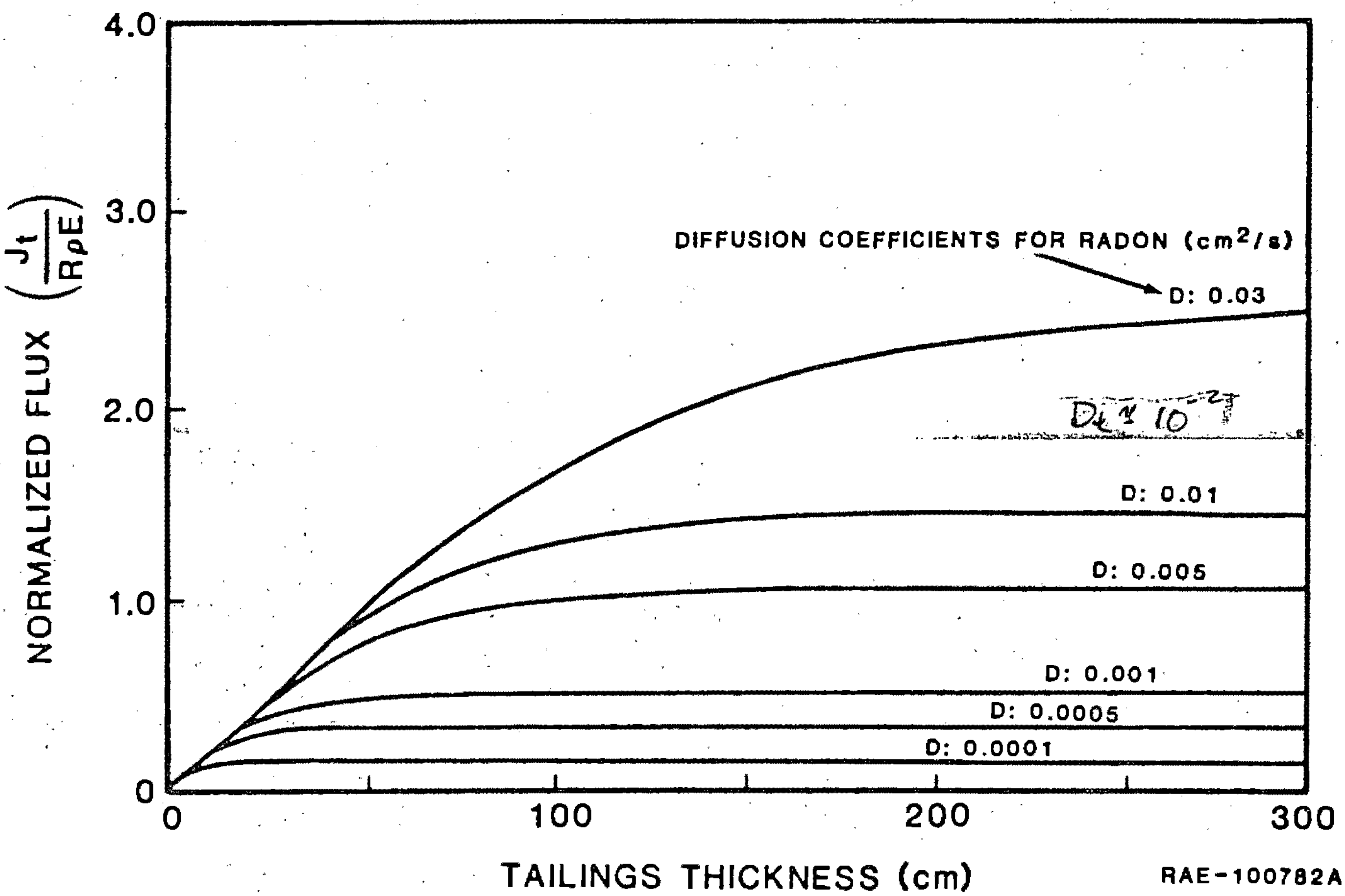


FIGURE 2. NORMALIZED FLUX FROM BARE TAILINGS AS A FUNCTION OF TAILINGS THICKNESS AND DIFFUSION COEFFICIENT.

$$x_c = \sqrt{\frac{D_c}{\lambda}} \ln\left[\frac{2J_t/J_c}{(1+\sqrt{a_t/a_c}\tanh b_t x_t) + (1-\sqrt{a_t/a_c}\tanh b_t x_t)(J_c/J_t)^2}\right] \quad (8)$$

Most practical applications require a significant degree of attenuation so that the last term in the denominator of Equation 8 can be neglected. The resulting simplified equation can be expressed in graphic form and is presented as a nomograph in Figure 4.[39]

The required cover thickness, x_c, is found by first determining the ratios J_c/J_t and a_c/a_t and then referring to the nomograph in Figure 4. The value of the ratio J_c/J_t is found on Column A and the value of a_c/a_t on Column B. These two values should be connected with a straight line, and a value read from Column C at the intersection with the line. That same value is located on the modified scale C' and a second line is drawn from that value on C' to the value of D_c on Column D. The intersection of the resulting line with Column E gives the cover thickness, in units of either meters or feet.

2.5 EXAMPLES OF SURFACE FLUX AND COVER THICKNESS DETERMINATIONS

Several examples are given in this section to illustrate the use of the equations and graphs. The first general examples are calculations of the surface flux from covered tailings. Figure 5 contains the results of cover calculations for a bare tailings flux of J_t = 280 pCi/m^{2}s. Various diffusion coefficients for the cover soils are used in Equation 4 to obtain the curves in the figure.[46] As shown in the next chapter, the cover moisture is the dominant parameter affecting the D, and hence, the radon attenuation.

As an example of the calculations used to generate the curves in Figure 5, it is assumed that a tailings pile has the following typical values:

R = 400 pCi/g

ρ = 1.5 g/cm^3

E = 0.2

D_t = 1.3×10^{-2} cm^2/s

p_t = 0.44

M_t = 11.7%

x_t = 300 cm

The radon flux from the surface of the uncovered tailings is calculated from Equation 3:

4. ESTIMATING DIFFUSION COEFFICIENTS

Radon diffusion coefficients for earthen materials have traditionally been determined from laboratory measurements with the subject soil at a prescribed moisture content and compaction. However, it is often desirable to estimate the diffusion coefficient of materials under varying conditions for which measured values are not available. This can be done with either complex models based upon physical characteristics of the soil, or upon empirical correlations based upon measured values of D. Both approaches are discussed in this chapter, and the advantages and disadvantages of each are given. Because soil moisture and compaction are important factors in the value of D for a given soil, they are also examined in detail in this chapter.

In order to predict the diffusion coefficient of radon from physical properties of an earthen material without conducting radon measurements, empirical correlations have generally been used. One of the earlier correlations is the correlation with moisture(55) which was used in the GEIS on uranium milling.(46) Another is a correlation with the air-filled porosity of the soil.(23) Although these correlations permit estimation of diffusion coefficients from soil properties rather than diffusion measurements, their basis is still a series of measured values of diffusion coefficients.

4.1 DIFFUSION COEFFICIENT MODEL

Recently, a theoretical model has been developed for estimating radon diffusion coefficients without relying on fitted parameters to radon diffusion data.(41) The formalism considers the detailed composition of the pore fluid as well as a statistical definition of the pore structure of the material. As illustrated in Figure 11, the pore fluid is modeled as a two-phase mixture of air and water, with radon diffusion occurring in both phases, and with radon exchange occurring between the air and water. The pore structure is modeled from the measured pore size distribution of the soil, and is described by the weighted average of all combinations of single and composite pores. The soil parameters required to estimate a radon diffusion coefficient are thus the moisture, the packing density and the pore size distribution.

Agreement between the model calculations and measured D values is generally within the experimental uncertainties in the data. A typical result is shown in Figure 12.(54) For the calculations, the pore size distribution was deduced both from water drainage curves and from particle size distributions.(54)

4.2 DIFFUSION COEFFICIENT CORRELATIONS

Empirical correlations for estimating D have the advantage of being simple and easy to use, with a minimal amount of information needed. One of the early correlations related D with the wet weight-percent moisture in the soil.[55] Subsequently, the development of the model for D revealed that the fraction of saturation, m, was the primary fundamental parameter characterizing D. A more recent correlation using the parameter, m, is recommended for use. It is given by:

$$D = 0.07 \exp\left[-4(m - mp^2 + m^5)\right], \tag{12}$$

and is plotted in Figures 10 and 12.

The relationship between the fraction of saturation, m, and the commonly-measured moisture percentage, M, is:

$$m = 10^{-2} M/(1/\rho - 1/g) , \tag{13}$$

where

ρ = dry bulk density (g cm^{-3})

g = specific gravity (g cm^{-3})

M = dry weight percent moisture (gm water/gm dry soil) x 10^2

The exponential argument in the correlation is a simple power series in m, where the first term defines the general downward slope. The second term contains the porosity influence and also causes a more gradual decrease with moisture in the pore filling region. The final term in the exponential argument accounts for major pore blockage near saturation and causes the more rapid decreases needed in this region.

4.3 UNCERTAINTIES OF D CORRELATION ESTIMATES

The correlation shown in Figure 10 has a geometric standard deviation of 2.0. However, individual estimates for a particular soil at a given moisture may be uncertain by as much as an order of magnitude, especially for higher values of m.

A reduction can be achieved in the error associated with a D value from the correlation if just one measurement is made with the candidate soil. In general, if the D at a given m for a specific soil is higher than the correlation, it will remain higher for other values of m. As seen in Figure 13, this is also true if the measured D is lower than the correlation. Values for the four soils shown in the figure also indicate the fact that materials with a wide range of particle sizes have lower D values. Therefore, by normalizing the correlation to a measured value for the D of a specific soil at a given m, more accurate estimates can be made for the D where

H = depth to the water table (ft)

Equation 14 can also be expressed in the form to estimate the dry-weight percent soil moisture:[59]

$$M = 3.1P^{1/2} - 0.03E + 3.9f_{cm} - 1.0 \qquad (16)$$

where M is the dry weight percent soil moisture.

4.5 COMPACTION EFFECTS ON DIFFUSION COEFFICIENTS

Compaction of the cover materials generally reduces the equilibrium D value. The dominant effect is from the increase in the equilibrium m; however, for some soils, D also decrease with greater compaction at a fixed m. For soils with higher compactions, such as represented by the data in Table 3, systematic biases from the correlation are observed for certain types of soils.

The soil description in Table 3 is based upon the percentage of clays and silts in the material, which is determined from the fraction passing a No. 200 mesh screen. As stated previously, the soils are placed into four groups, according to the fraction passing a No. 200 sieve.

Diffusion coefficients from the first group are an average of 20 percent lower than the correlation, and those from the second group are 50 percent lower. Those in the third group are within one percent of the correlation, on the average, and the fourth group averages 30 percent higher than the correlation. These biases should be applied to the correlation in Equation 12 if it is used to obtain an estimate of D. For example, for a soil with f_{cm} less than 0.3, the D obtained from Equation 12 can be divided by 1.2 to obtain a more accurate estimate of D.

The biases are consistent with predictions from the diffusion coefficient computer model.[41] A material with a high clay-silt content is not as effective in attenuative radon as a material with a wide range of particle sizes, for a given saturation percentage. These characteristics should be considered when selecting cover materials.

A significant increase in the lower limit of the volumetric water content, θ, also occurs for many soils at higher compactions. The increase was particularly significant for densities exceeding 1.5 g/cm^3.[26,60] Examination of the relationship between m, θ and porosity, p, is helpful in explaining the increases

$$m = \theta/p \qquad (17)$$

5. OTHER FACTORS INFLUENCING RADON MIGRATION

Three other factors influencing radon migration warrant consideration. They are the source term (the tailings), the effects of defects in the cover, and the effects of advection.

5.1 RADON SOURCE TERM

Characterization of the source term is a major step in performing the design analysis of an adequate cover system. As given by Equation 3, the key parameters for the source term are the radium concentration, the dry bulk density, the emanating power, and the diffusion coefficient.

Values for the radium concentration, R, of tailings can be measured directly from tailings samples by the radon equilibrium method, and by direct gamma spectroscopy.[26,61] If a radium analysis is not available, it can be estimated quite accurately from the uranium concentration of the ore as specified by the ore grade, using the following equation:

$$R = K_a G \qquad (18)$$

where

G = ore grade (wt% U_3O_8)

K_a = 2812 pCi (^{226}Ra) per gram soil/(wt% U_3O_8)

This equation presumes equilibrium between the uranium and radium in the ore and all radium being contained in the tailings.

The bulk density, ρ_b, of the solid tailings material is a relatively easy measurement to perform. In the absence of measured data a typical value of 1.5 g/cm^3 can be used for the bulk dry density. The density of most tailings piles will be within 35 percent of this value.

The emanating power, E, for uranium tailings is the fraction of the radon generated that is free to diffuse in the pore spaces. It has been shown recently[62] that E varies with moisture. As shown in Figure 15, E can vary considerably for different tailings piles.[59] However, for most practical applications with uranium tailings, a value of 0.2 is a reasonable estimate of E. The data shown in Figure 15 are based upon a few grab samples per pile.

5.2 SOURCE TERM IMPACTS ON RECLAMATION DESIGN

The utilization of source term information can have beneficial impacts

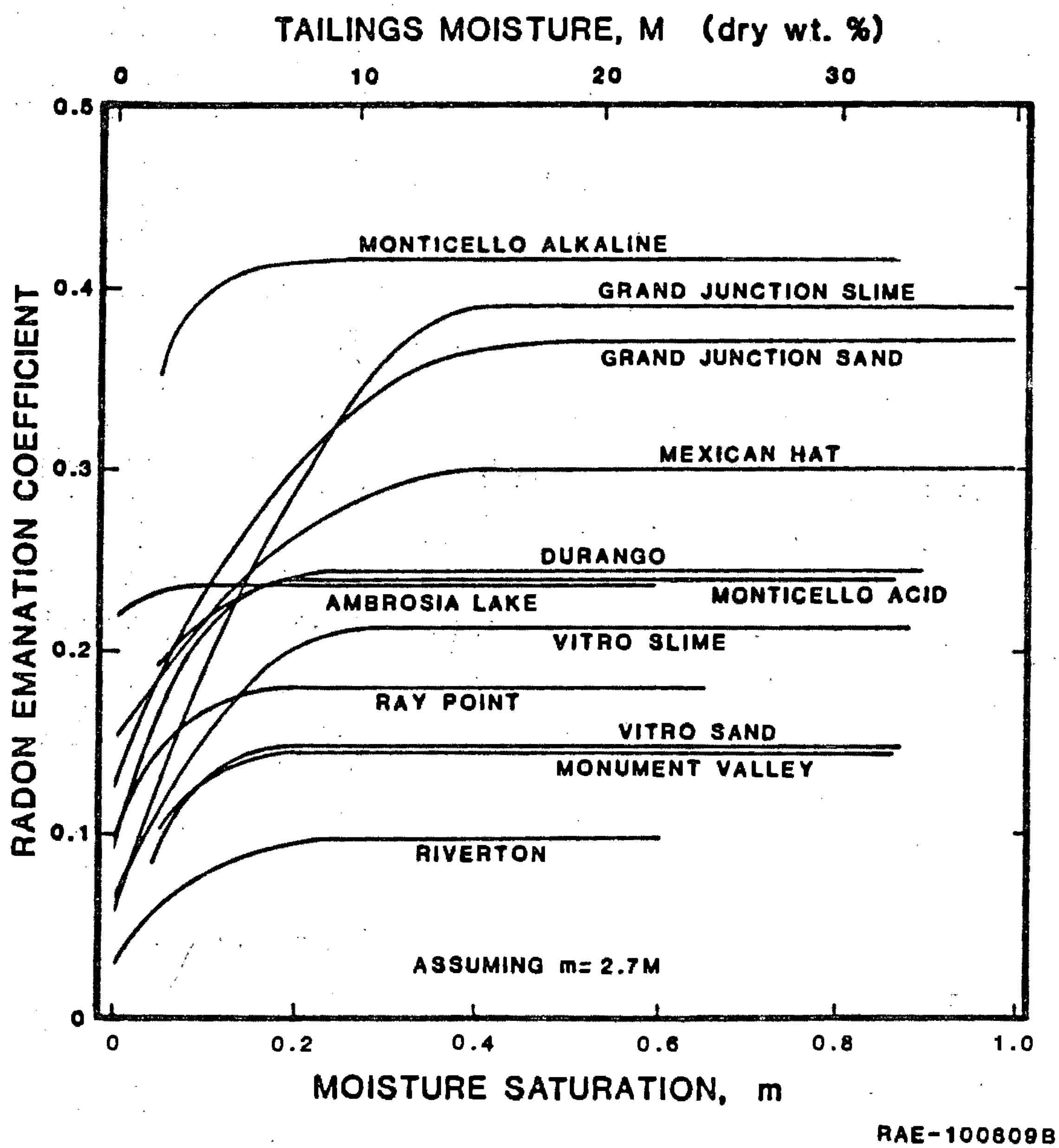


FIGURE 15. RADON EMANATION COEFFICIENTS FOR TAILINGS SAMPLES.

25
Ue. 2407

Doc

NUREG/CR-2407
PNL-4071

Radon and Aerosol Release from Open Pit Uranium Mining

Prepared by V. W. Thomas, K. K. Nielson, M. L. Mauch

Pacific Northwest Laboratory
Operated by
Battelle Memorial Institute

Prepared for
U.S. Nuclear Regulatory Commission

TABLE 8. Arithmetic Mean Specific Radon Flux Comparison with Other Studies

SURFACE	AVERAGE SPECIFIC FLUX pCi/m^2-sec-% U_3O_8	REFERENCES
Soil	2,500	Wilkening, 1960 - Ref. 16
Soil	2,400	Junge, 1963 - Ref. 17
Soil	620	Clements, 1974 - Ref. 18
Undisturbed Topsoil Near Casper, WY	1,900	Thomas, 1982 - This Work
Undisturbed Topsoil on Mine Properties	2,200	"
Topsoil Piles at Mines	5,700	"
Overburden Piles	2,500	"
Recovered Overburden Piles	2,200	"
Undisturbed Ore in Mine Pit	204	Carson, 1980 - Ref. 19
Ripped Ore in Mine Pit	48	"
Mine Pit Floors	3,200	Thomas, 1982 - This Work
Ore in Mine Pits	3,200	"
Ore Piles at Mines	6,200	"
Lower Grade Ore Piles	5,400	"
Aged Tailings Piles (1)	~1,000	Carson, 1980 - Ref. 19
Tailings Piles (1)	3,300	Silker, 1979 - Ref. 20

Footnote:
(1) These values were calculated from results reported as if the ^{226}Ra present was in equilibrium with ^{238}U.

REFERENCE # 37

NAVAJO SUPERFUND OFFICE

BROWN VANDEVER URANIUM MINE REFERENCE MATERIAL

MAY, '90 P. MOLLOY

RADON TESTING

RADON FLUX: Standards 40 CFR Part 61 Subpart T
40 CFR Part 192

Average 1 year over disposal -- 20 pci/m^2/sec
Annual average at any location outside -- .5 pci/m^2/sec

Terry McLaughlin -- 703-308-8760
HQ OAR 460
Washington, D.C

Standards and technologies outlined in federal registry 12/15/90.

Denver Specialist -- Phil Nyberg FTS 330-1686

Superfund Site Strategy Recommendation Region 6

Site Name: Navajo - Brown Vandever Uranium Mine Site Number: NMD986669117

Alias Site Name(s):

Address: Four Miles ENE of Bluewate, NM

City/County or Parish/State/Zip: Bluewater/McKinley/NM/87045

Recommendation:

[ ] 1. No further remedial action planned under Superfund.

[XX] 2. Further pre-remedial investigative action needed under Superfund:
PA_______ Priority: High XX
SSI XX_______ Medium_______
To be performed by Navajo

[ ] 3. Action may be appropriate under other authority:
NPDES_______ SPCC_______ 404_______ TSCA_______
UIC_______ SMCRA_______ STATE_______ RCRA_______
OTHER ERB

Discussion: PA

The Brown Vandever Mine contains about 1880 tons of uranium mine tailings abandoned on-site. Small quantities of ore grade material are found scattered over the site. The material is easily accessible by site residents and visitors. There are several uncovered ventilation shafts, timbered shfts and inclined adits on the site. There are no warning signs or fences preventing access to the site. The population within 1/4 mile of the site is around 75 persons. Over 30 children are known to play on the tailings in the immediate vicinity of the mine. The road to the site is paved with tailings. There is potential for exposure of individuals via the air pathway as some of the material is fine, and Radon is also emitted from the slag material. The primary substances of concern are Uranium, and its progeny Th 232, Bi 214, Po 214, isotopes of Pb and Radon gas. The heavy metals potentially present in the mining waste are arsenic, barium, magnesium, manganese, strontium, titanium, and zinc. Many of these materials have been demonstrated to be mobile in waters associated with Uranium mines. Three wells and a spring are located within a 4 mile radius, and serve approximately 430 persons. Ground water from 2 of the wells is at 400 feet. The adits from the mine reach to within 100 feet of the groundwater and might convey contaminants. There is no surface source of water used by the people for drinking water. Because of the air pathway and soil exposure routes as well as the potential for ground water contamination, this site is recommended for a Screening Site Inspection.

Copies to (please list) NAVAJO SF, 6T-AS, 6E-E, 6W-S, ATSDR

Recommended By: Barbara Driscoll Date: 7/17/90

Approved By: Bill Taylor for Betty Williamson Date: 7/17/90

THE NAVAJO NATION

LEONARD HASKIE
INTERIM PRESIDENT
NAVAJO NATION

IRVING BILLY
INTERIM VICE PRESIDENT
NAVAJO NATION

6/11
> 6H-MA

NSO-90-62

April, 06 1990

Mark Satterwhite
Superfund Indian Coordinator
U.S. EPA Region VI
1445 Ross Avenue
Dallas, Texas 75202

Dear Mr. Satterwhite:

Enclosed is the Preliminary Assessment (PA) Package for the Brown Vandever Uranium Mine, located near Bluewater, New Mexico. This report receives NSO internal approval and is now ready for your review and comment.

Please call myself or Patrick Molloy, the Health Physicist who prepared the package, for any questions you may have regarding the report. We would appreciate a response in the form of comments or approval at your earliest convenience. You may reach myself or staff at (602) 871-6859, 6860 or 6861.

Sincerely,

Clara Bia
Navajo Superfund Director

Enclosures

cc: Peter Sam, William Taylor, Superfund Site Assessment Section
Deborah Vaughn-Wright

NAVAJO SUPERFUND OFFICE

NAVAJO - BROWN VANDEVER URANIUM MINE

PRELIMINARY ASSESSMENT NARRATIVE

JUNE '90

P. MOLLOY

PRELIMINARY ASSESSMENT

DATE : May 20, 1990

Prepared by: Patrick Molloy, Health Physicist, Navajo Superfund Office

Site : Navajo - Brown Vandever Uranium Mine

EPA ID # : Not assigned

SITE INFORMATION

Site Location. The Brown Vandever Uranium Mine (Brown Uranium Mine, sic)is located approximately 4 miles east of Prewitt, New Mexico. The site is also located approximately 20 miles north-northwest of Grants, New Mexico (figure# 1). The site may be found by proceeding east from the Prewitt, New Mexico post office on the Interstate 40 frontage road approximately 1 mile and subsequently traveling east on an improved dirtroad for approximately 5 miles (figure #2). The road turns north at the eastern edge of Haystack mountain, a prominent geological feature in the area. The site is located on the southeastern margin of Haystack mountain approximately 1 mile north of El Tintero cinder cone (figure #2). The Geographic coordinates for the site are 35° 21' 02" N latitude and 107°56'25" W longitude (7).

The mine is located on an expired mining claim of approximately ¼ section in area. Approximately 65 persons, including small childern live on-site in a semi-agricultural rural setting (3,4; worksheet #2, 7). Two inclined adits, an almost vertical timbered shaft, two vertical ventilation shafts and a strip mine covering approximately 100 acres are notable features of the abandoned claim (3; Frames).

OWNER AND OPERATOR. The Brown Vandever Mine is currently owned, and was owned throughout its history by the Navajo Nation (17). The land is held in trust for the Navajo Nation by the Federal Government through the authority of the Bureau of Indian Affairs (BIA).

The primary lease holders for the claim were variously; Williams and Thompson (full names not found) and Mr. Brown Vandever (2;pg 1-276, 3-5). The site was presumably subleased to the various operators (2; page 3-5). Several other mines are to be found in the area the most notable being the Haystack 2 mine (11). The lease is currently owned by the Navajo Nation (17).

PURPOSE OF INVESTIGATION The Brown Vandever Uranium Mine was reported to be a potentially contaminated waste site by the Navajo Superfund office field reconnaissance team in 1990 (1).

SITE HISTORY The Brown Vandever Uranium Mine is located in the Ambrosia Lake sub-district of the Grants Mining District (7,10). No Historical record for naturally occuring radiation levels for the area has survived until the present. Two inclined adits were driven north-northwestward into the dip of the Todilto formation (3;frame #12, figure #4). These inclines were reported to be approximately 300 ft. deep (14; page #6, direct quote): additionally, two 400 yd. drifts were driven into the ore bodies associated with the incline in Frame #12 (14; page #2).

A timbered shaft inclined at approximately 10° from the vertical, was driven into the dip of the Todilto formation approximately 1000 ft. west of the inclined adits (3; frame #33). This shaft was reported to be approximately 300 ft. deep (14; page #6): drifts were also excavated northwest and northeast from the shaft.

Two, two-foot diameter vertical shafts were excavated between the inclined adits and the timbered shaft in order to provide ventilation for the mining operation (3; frame #33); the ventilation shafts were reported to be approximately 300 ft. deep (Mr. Brown Vandever, personal communication, April 11, 1990).

The area south of the inclined adits has been extensively strip-mined: The area of surface disturbances has been estimated to be approximately 100 acres in extent (4; page # 8, Figure #2). Tailings associated with the N. and B. Vandever Mines were used to "pave" a road leading to the N. Vandever works.

It is presumed that the mining operation was carried out using conventional mining techniques; Due to the extensive and elaborate nature of the surface works and adits (shafts), it is unlikely that manual labor was utilized to any great degree. A powerline extension which was used to provide electricity for an air compressor still exists on site.

The Brown Vandever Uranium Mine was operated intermitently over the period of years from 1952 until 1966 (2). Santa Fe Uranium, Federal Uranium Mesa Mining Co. and Cibola Mining Co. were some of the mining interests involved: Other individuals operated the mine (2).

Mining operations at the site produced 25,796 tons of ore rich in Uranium (U_3O_8,0.) 0.19% grade) and Vanadium (V_2O_5, 0.30% grade). A total of 98,175 lbs of U_3O_8 and 75,342 lbs of V_2O_5 were milled from the raw production tonnage (2, pg# 1-276, 3-5).

It is presumed that the ore was transported to Shiprock, New Mexico or Durango, Colorado for milling. However, no record of where the milling took place was found: It is not known whether the Phillips Petroleum Ambrosia mill was in operation during the time the ore was being produced.

DISSCUSSION OF KNOWN/POTENTIAL PROBLEMS During a windshield survey of the site and environs, in order to ascertain population, population distribution, water usage patterns and area radiometric background

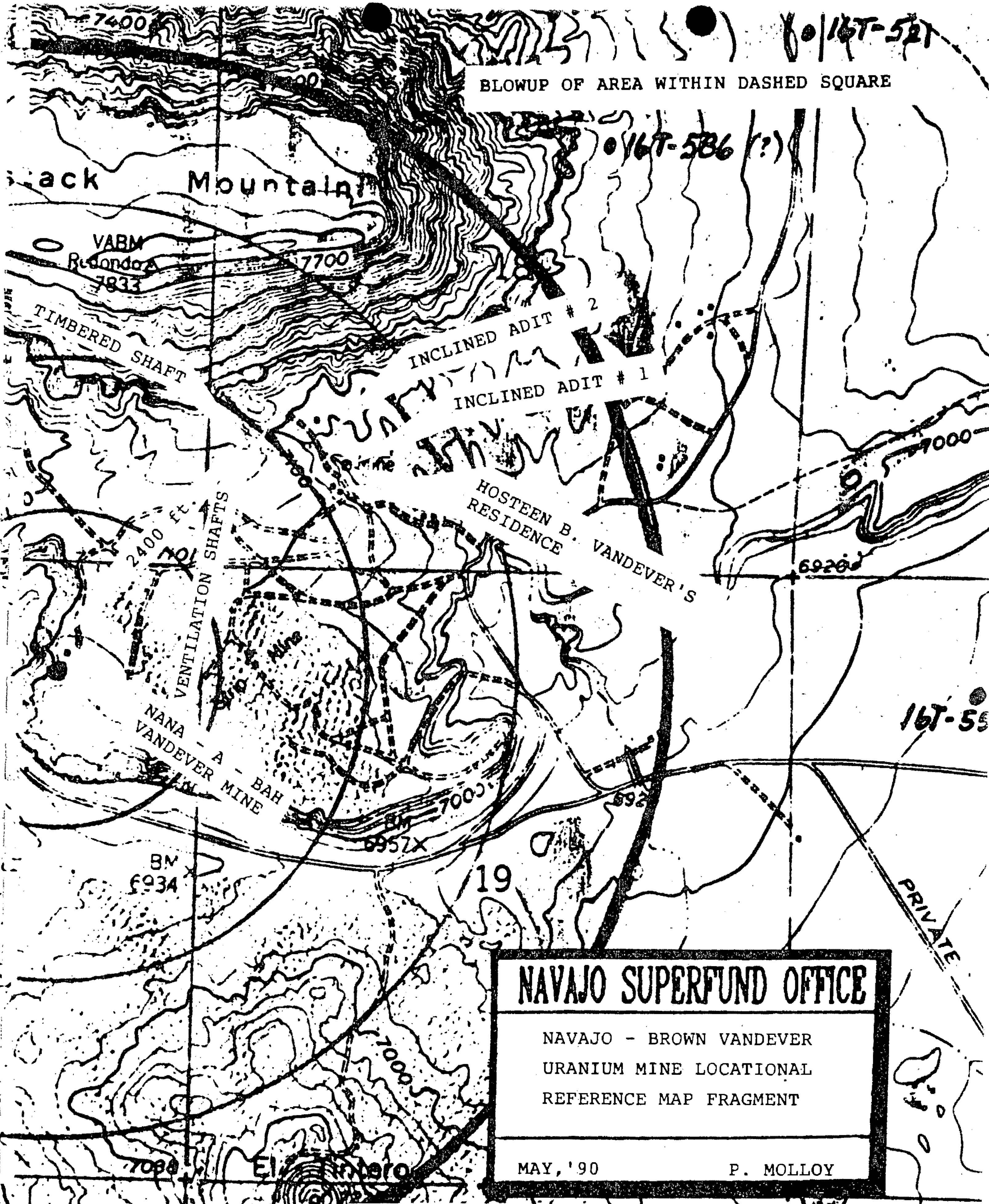


FIGURE # 2 ; AFTER USGS BLUEWATER QUADRANGLE MAP

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

DATE APRIL 11,1990 **TIME** 10:20am **WEATHER** CLEAR

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 20°/ENE

FILM TYPE POLAROID **FRAME NO.** 5

DATA TAKEN WITH PHOTOGRAPH: NONE

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ____________
4. Radiation Survey ( )
   Reading: ____________
5. Deep Well Water Sample ( )
6. Photograph Below: YES

5TH FR

7. **DESCRIPTION** HAYSTACK BUTTE, REFERENT, LOOKING E OF ENE

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

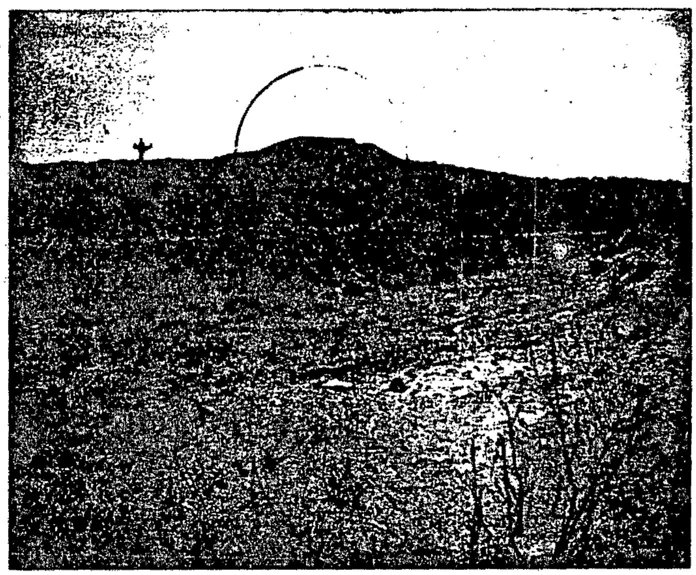
DATE APRIL 11,1990 **TIME** AFTERNOON **WEATHER** CLEAR

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 270°/S

FILM TYPE POLAROID **FRAME NO.** 20'

DATA TAKEN WITH PHOTOGRAPH: *** NONE ***

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: __________
4. Radiation Survey ( )
   Reading: __________
5. Deep Well Water Sample ( )
6. Photograph Below: YES



20TH FR. (EL TINTERO
CINDER CONE, REF. 1

7. **DESCRIPTION** EL TINTERO CINDER CONE REFERENT, LOOKING S

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

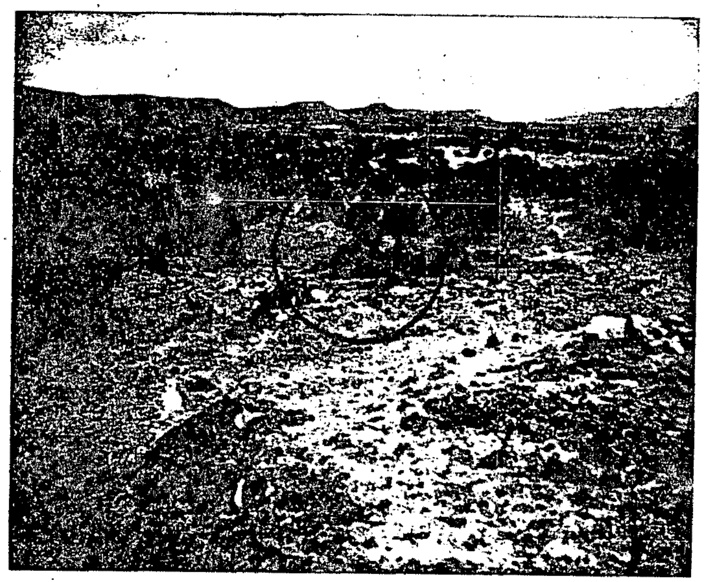
DATE APRIL 11,1990 **TIME** 10:25am **WEATHER** CLEAR

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 20°/ENE

FILM TYPE POLAROID **FRAME NO.** 7

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ________
4. Radiation Survey (x)
   Reading: LUDLUM#19-24uR.hr^{-1} :: ESP-II - 2.2(10^4)
5. Deep Well Water Sample ( ) BACKGROUND @ B VANDEVER
6. Photograph Below: YES



7TH FR.

7. **DESCRIPTION** TRENCH CUT NNE OF B. VANDEVER RESIDENCE, LOOKING NE. NOTE FRAMES 8, 9, 10 TAKEN AT SAME LOCATION

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

DATE APRIL 11,1990 **TIME** 10:25am **WEATHER** CLEAR

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 10°/N OF NNE

FILM TYPE POLAROID **FRAME NO.** 15

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ______
4. Radiation Survey (X)
   Reading: 350uR.hr^{-1}(LUDLUM#19) : @ EDGE OF "LOADING BAY"
5. Deep Well Water Sample ( )
6. Photograph Below: YES

15th FR.

7. **DESCRIPTION** TRENCH AT CENTER MIDDLEGROUND IS ORE "LOADING BAY", LOOKING N OF NNE

levels, the following observations were made;

* The population distribution is closely correlated with the Indian Health Service (IHS) water system (tautological).

* Several windmills in the area are no longer in service. At least one windmill shows infrequent use (18; pg #1).

* There are 7 residences on site: not all these residences are connected to the IHS water system.

* The old haulage road (for ore transport) is plainly visible and shows definite erosion: The road that obtains access to the site was at one time the haulage road. There is radiometric evidence that contaminants are migrating off site (18, pg #2).

* A drainage which trends east from the site exhibits radiometric readings consistent with contaminant transport/migration.

* The onsite haulage road was "paved" with mine tailings and provides a receptacle for mechanical transport of contaminants. An Eberline Gamma Ratemeter registered 10^5 cpm at the edge of the road (3; frame #22, 14; page #4) There is radiometric evidence of mechanical (eg, vehicle) transport of contaminants approximately 2 mi. from the site environs via the haulage road (18; page #2)

* The timbered shaft retains a shack at its mouth, however, access to the shaft can easily be gained by removing a wire grate covering the portal (3: Frame #33). Additionally, the shaft "aspirates" under certain meteorological conditions, contributing to the area Radon burden.

* The vertical ventilation shafts are poorly capped and young children in the area could easily gain access to the excavations (3; Frame #33).

* One inclined adit is used for waste disposal (3; Frame #12).

* Small quantities of ore grade material are to be found almost anywhere on site.

* Approximately 1880 tons of tailings materials are presently onsite. The material is uncovered and accessible (3.; Frames #8, #13, #15, #19, Frames #25 through #32).

* The Navajo Superfund Office FIT digilert alerted (enabled) inside the vehicle being used for reconnaissance at one point along the "Hot Road" (3; Frame #22): enable/alert on the device is set at .098 mR.hr-1.

Tailings material, the inclined adits and the timbered shaft are suspected of producing a leachate rich in toxic heavy metals and radioactive contaminants (4,11,23). Radiometric readings taken during

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

DATE APRIL 11, 1990 **TIME** 11:15am **WEATHER** CLEAR TO SLIGHTLY OVERCAST

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 180°/W

FILM TYPE POLAROID **FRAME NO.** 16'

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ______
4. Radiation Survey (X)
   Reading: SEE BELOW IN DESCRIPTION
5. Deep Well Water Sample ( )
6. Photograph Below: YES , EXTRA FRAME

16TH FR.
MOUTH OF DRAINAGE

7. **DESCRIPTION** MOUTH OF DRAINAGE, TAILINGS PILE ON RIGHT, ESP-II READINGS: @MOUTH - $5(10^4)$; @MIDWAY PAST TAILINGS - $6.5(10^4)$; @END OF TAILINGS - $3.25(10^4)$; ALL READINGS IN cpm., LOOKING W

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

DATE APRIL 11,1990 **TIME** AFTERNOON **WEATHER** CLEAR

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 0°/E

FILM TYPE POLAROID **FRAME NO.** 22

DATA TAKEN WITH PHOTOGRAPH: YES

1. **Soil Sample** ( )
2. **Surface Water Sample** ( )
3. **Air Monitoring Device** ( )
   Reading: ______
4. **Radiation Survey** (x)
   Reading: 10^5cpm(ESP-II) @ EDGE OF ROAD
5. **Deep Well Water Sample** ( )
6. **Photograph Below:** YES

22nd Fr.

7. **DESCRIPTION** "HOT ROAD" WEST OF B. V. RESIDENCES, SURFACE WORKS WASTE PILES @ RIGHT MIDDLEGROUND, MT. TAYLOR @ UPPER LEFT BACKGROUND AS REFERENT

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. ~~NOT ASSIGNED~~

DATE APRIL 11,1990 TIME AFTERNOON WEATHER CLEAR TO SLIGHTLY OVERCAST

PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 135°/NW

FILM TYPE POLAROID FRAME NO. 33

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ______
4. Radiation Survey (X)
   Reading: $10 uR.hr^{-1}$(LUDLUM#19), 10^4cpm(ESP-II) @ WEST FACE OF SHACK.
5. Deep Well Water Sample ( )
6. Photograph Below: YES

33 FR.

7. DESCRIPTION B. VANDEVER TIMBERED SHAFT, SHAFT AT AN INCLINATION OF 10° FROM VERTICAL, CIRCULAR APERTURE ON S FACING WALL IS WIRED OVER BUT WIRE IS EASILY REMOVED, SHAFT ASPIRATES, "300 FT. DEEP" B. V. TO P. MOLLOY, APRIL 11,1990

PCM

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

DATE APRIL 11,1990 **TIME** AFTERNOON **WEATHER** CLEAR TO SLIGHTLY OVERCAST

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 250°/WNW

FILM TYPE POLAROID **FRAME NO.** 33

DATA TAKEN WITH PHOTOGRAPH: *** NONE ***

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ______________
4. Radiation Survey (X)
   Reading: ______________
5. Deep Well Water Sample ( )
6. Photograph Below: YES

33rd FR.
(VENT. SH. VERTICAL!)

7. **DESCRIPTION** VERTICAL VENTILATION SHAFTS(2), HOSTEEN BROWN VANDEVER AT RIGHT MIDDLEGROUND. SHAFTS "300 ! FT. DEEP" - B. V. TO P. MOLLOY, APRIL 11,1990, LOOK-WNW

(PCM)

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

DATE APRIL 11,1990 **TIME** 10:25am **WEATHER** CLEAR

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 110°/NNW

FILM TYPE POLAROID **FRAME NO.** 12

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ______________
4. Radiation Survey (X)
   Reading: LUDLUM#19 - 21uR.hr^{-1} : @ FACE OF ADIT
5. Deep Well Water Sample ( )
6. Photograph Below: YES

12TH FR.

7. DESCRIPTION INCLINED ADIT N OF B. VANDEVER RESIDENCE, LOOKING NNW

PIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

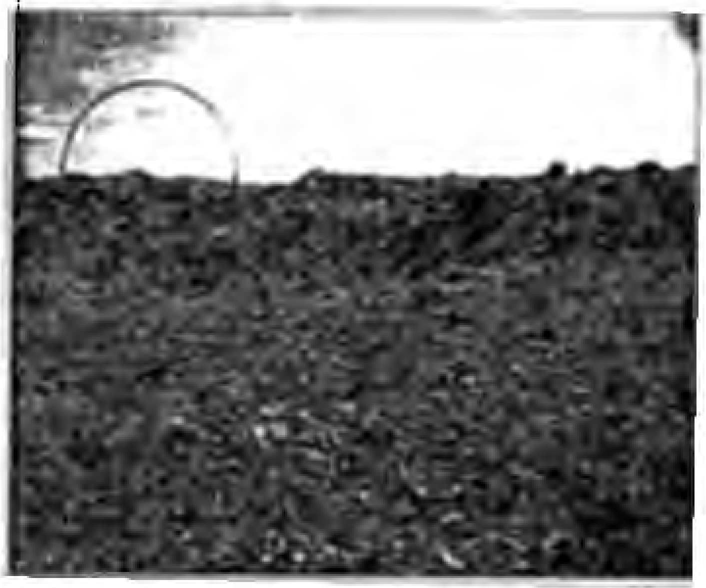
DATE APRIL 11,1990 **TIME** AFTERNOON **WEATHER** CLEAR

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** 350°/E OF ESE

FILM TYPE POLAROID **FRAME NO.** 26

DATA TAKEN WITH PHOTOGRAPH: *** NONE ***

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading:__________
4. Radiation Survey (X)
   Reading:__________
5. Deep Well Water Sample ( )
6. Photograph Below: YES



26 Int Fr

7. **DESCRIPTION** SURFACE WORKS WSW OF B. V. RES., LOOKING E OF ESE; NOTE MT. TAYLOR IN FAR LEFT BACKGROUND AS REFERENT

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

DATE APRIL 11,1990 **TIME** _______ **WEATHER** CLEAR

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** _______

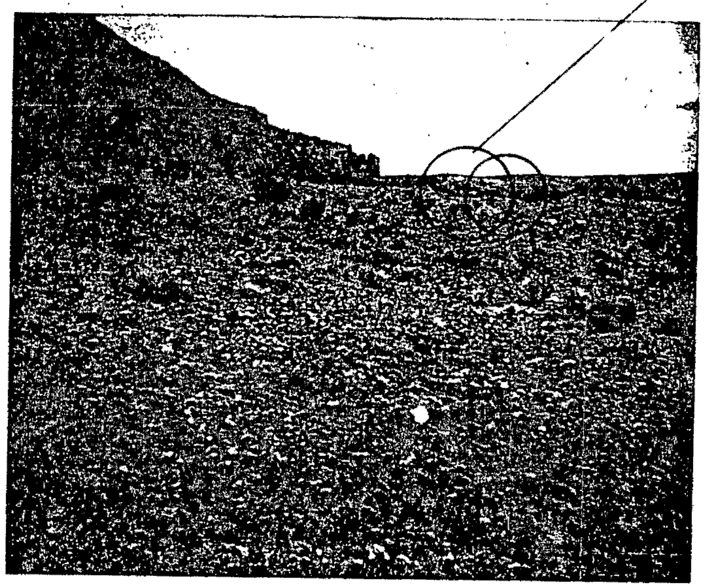
FILM TYPE POLAROID **FRAME NO.** 28

DATA TAKEN WITH PHOTOGRAPH: *** NONE ***

1. **Soil Sample** ( )
2. **Surface Water Sample** ( )
3. **Air Monitoring Device** ( )
   Reading: _______
4. **Radiation Survey** (X)
   Reading: _______
5. **Deep Well Water Sample** ( )
6. **Photograph Below:** YES, SEE SKETCH

RES, UNOCCUPIE[illegible]

PCM



3 RES;

28th Fr.

7. **DESCRIPTION** SEE SKETCH

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

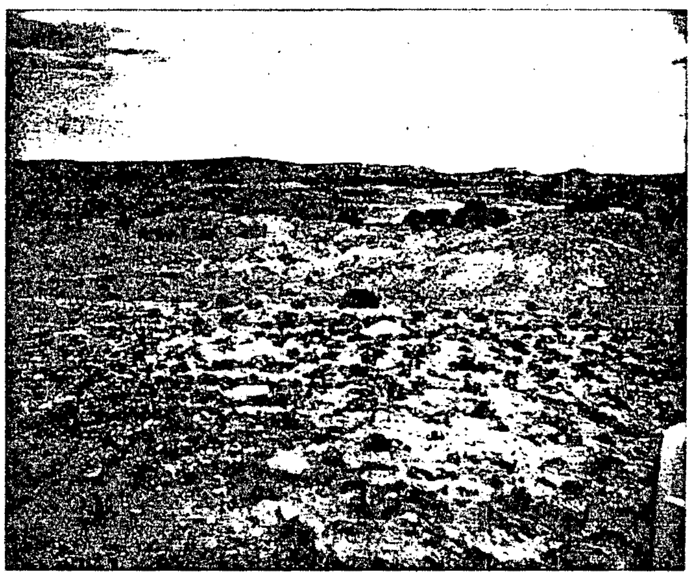
DATE APRIL 11,1990 **TIME** 11:15am **WEATHER** CLEAR TO SLIGHTLY OVERCAST

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** SEE SKETCH

FILM TYPE POLAROID **FRAME NO.** 31

DATA TAKEN WITH PHOTOGRAPH:

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ______
4. Radiation Survey (x)
   Reading: ______
5. Deep Well Water Sample ( )
6. Photograph Below: YES



31ST FR.

7. DESCRIPTION ______

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE **USEPA SITE NO.** NOT ASSIGNED

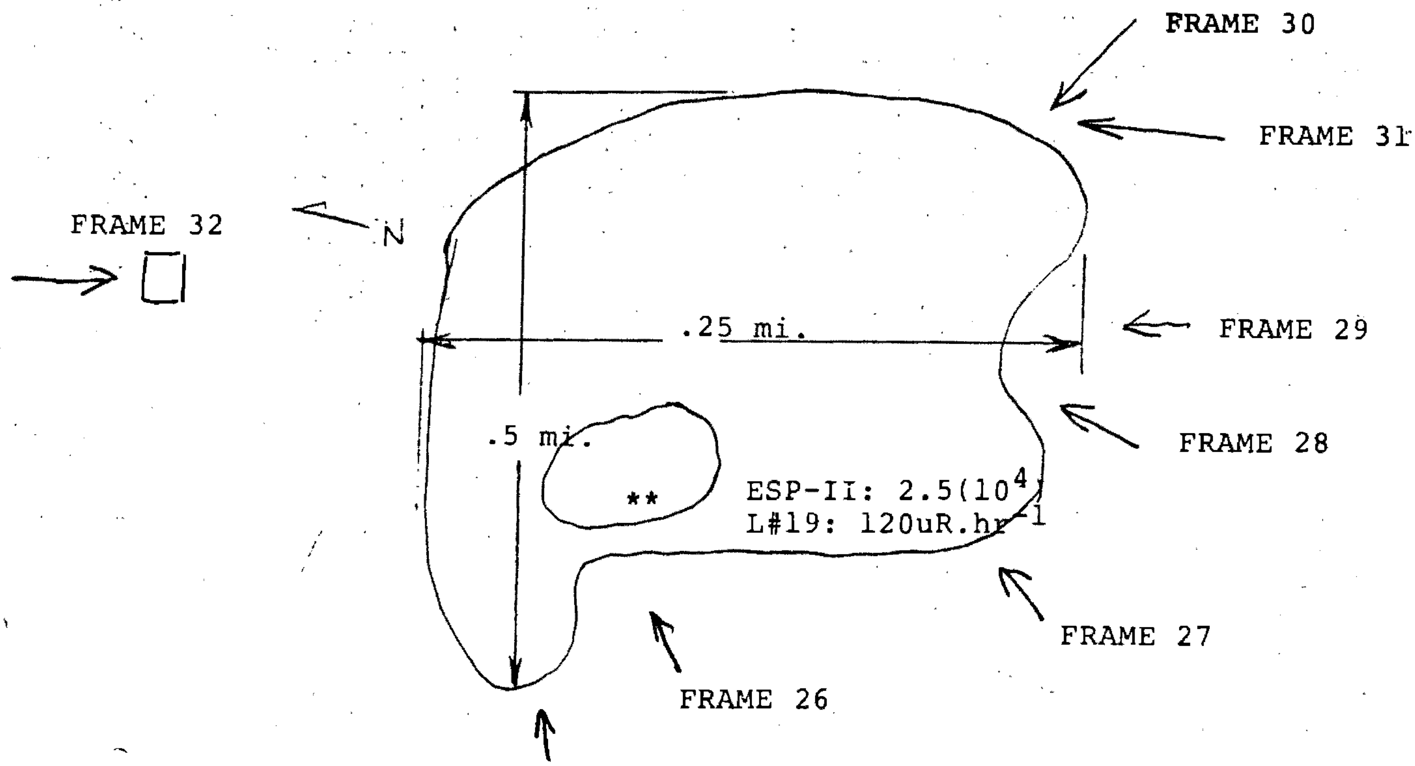
DATE APRIL 11,1990 **TIME** 11:15am **WEATHER** CLEAR TO SLIGHTLY OVERCAST

PHOTOGRAPHER P. MOLLOY **ANGLE/DIRECTION** -

FILM TYPE POLAROID **FRAME NO.** NO FRAME

DATA TAKEN WITH PHOTOGRAPH: SKETCH

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )
   Reading: ______________
4. Radiation Survey (x)
   Reading: SEE BELOW
5. Deep Well Water Sample ( )
6. Photograph Below: *** NONE ***



* RADIOMETRIC READINGS ASSOCIATED WITH FRAME 27

7. **DESCRIPTION** SKETCH OF AREA WHERE RADIOMETRIC READINGS WERE TAKEN, NO SCALE

a windshield survey indicate that a substantial fraction of ¼ of a section (160 acres) is contaminated with mine tailings. Tailings piles, the incined adits and the timbered shaft are unfenced and readily accesible to site residents (3). There is no documentation of emergencies, accidents or remedial action regarding the Brown Vandever Uranium mine site.

3. WASTE CONTAINMENT/HAZARDOUS SUBSTANCE

An estimated total of 532,000 tons of mining waste is present in the two major tailings piles on site (4). Computations indicate that there are approximately 1880 tons of toxic compounds and elements dessiminated within the 532,000 tons of rubble at the site (3; Frames #8, #13, #15, #19, #25 through #32, 4). These contaminants are exposed and uncontained and are therefore capable of producing leachate subject to migration into atmospheric, ground water and surface water systems (11, 22, 23, 24, 25). The exposed inclined adits, timbered shaft and stopes may also be producing a leachate similar in composition to that produced by the tailings piles.

Specific radioactive species contributing to contamination of the leachate are uranium (U^{235}, U^{238}), and its daughter products Ra^{226}, Th, isotopes of Pb, Bi^{214}, etc). The enclosed portions of the adits and shaft may contain significant concentrations of Radon gas. Toxic heavy metal species suspected of being present in the mining waste in significant concentrations are Vanadium, Arsenic, Barium, Chromium, Magnesium, Manganese, Strontium, Titanium and Zirconium. Table 1 provides a summary of hazardous substances potentially present in the waste piles and in the open excavations.

4. PATHWAY CHARACTERISTICS

A. AIR CHARACTERISTICS

The potential for mobility of hazardous and toxic compounds associated with U_3O_8 and V_2O_5 mining waste is high due to the particulate nature of the waste and the occasional high winds native to the area which may cause migration of windblown contaminants offsite.

B. GROUNDWATER CHARACTERISTICS

Regionally, the site is bounded on the north by the central San Juan Basin and on the south by the Zuni uplift. Structural elements of the Acoma Sag lie southeast of the site (5;pgs 16,18:6). The geological element where the site is located is termed the Chaco slope (5;pg 16).

"Kelley (1951, p. 126) describes the Chaco slope as the southern part of the San Juan Basin that lies between the central Basin (fig. 2.5 -1) and the Zuni uplift and Acoma Sag. The Chaco slope resembles the platforms but differs from them because of "Its more pronounced and continous regional inclination toward the center of the basin and by the absence of a 'Monocline' separating it from the central basin " (Kelley, 1951, p.126).

Jurassic rocks from the Morrison formation and Chinle formation (which

TABLE 1. Quantity of Undisseminated Toxic Compounds and Elements Within Tailings Piles at Brown Vandever Uranium Mine

	Waste	Quantity of Undisseminated Hazardous Waste*	Disposal Location	Origination
1.	U_3O_8	6.35 (10)kg	On-Site	Low Grade Uranium/ Vanadium
2.	V_2O_5	**1.04** (10)kg	On-Site	" "
3.	Radium	Unknown	"	" "
4.	Thorium	"	"	" "
5.	Arsenic	"	"	" "
6.	Selenium	"	"	" "
7.	Radon	"	"	" "
	TOTAL	**1880 tons**		

* CUSTOMARY UNITS FOR REPORITNG ABUNDANCES OF RADIOISOTOPES ARE MASS UNITS.

locally includes the Moenkopi formation) dip westwardly into the adjacent Chaco slope' (3; frame# 20 and enlargement: 6:8). A Cretaceous sequence is present adjacent to the site on Haystack mountain and is represented by the Dakota sandstone exposure (3: frame #20 and enlargement). Triassic units represented by the Moenkopi and Chinle formations dip eastwardly into the adjacent Chaco slope (3;frame #20 and enlargement Figure #3).

Quaternary Alluvium (Pleistocene) has accumulated in variable thicknesses in streambeds in the area (32).

The Aquifer of concern in the Vicinity of the site is the Sonsela Sandstone member of the Chinle formation which sources the Navajo Nation Water Resources Division (NNWRD) well #16T-551 (19). Depth to water in ths well is documented and is reported to be 417 feet (circa 1976). Depth to the Sonsela sandstone member of the Chinle formation is 1083 feet. The only other Aquifer known to source wells in the area is the Entrada Sandstone (19). the net precipitation for the locale is estimated to be minus 44 inches (5, 12).

Contaminants of concern present in the tailings piles are the radiospecies U^{238}, U^{235} and their progeny Th^{232}, Bi^{214}, Po^{214}, isotopes of Pb and Radon gas. Toxic heavy metal species suspected of being present in the mining waste in significant concentrations are Ar, Ba, Mg, Mn, Sr, Ti and Zr. (11, table 1). Many of these species have been demonstrated by various authors to be mobile in waters associated with Uranium mines (23,24,25,26,27,28 and 29). The Hydraulic conductivity of the formations between the Alluvium and the Sonsela sandstone member is estimated to be of the order of 10^{-3} because of fractures and faults. This is consistent with the close proximity of the El Tintero Cinder Cone and the epochal geological development of the area. In addition, at least three excavations are driven to within 100 feet of the static water level in NNWRD well #16T-551. It follows that the possibility exists for these Radioactive and toxic heavy metal species to have migrated into the alluvial and Sonsela sandstone Aquifers which source an Artesian spring and NNWRD well #16T-551, respectively (3; frame #35: 19). Water depth in the alluvial Aquifer is not known but is expected to be shallow (5; pg. #40, fig.#4.3-1)

C. SURFACE WATER CHARACTERISTICS

A portion of the Brown Vandever mine site is located on a southeastwardly dipping Alluvial plate (3;frame #8) whose upgradient drainage area is estimated to be approximately 59.1 acres (4; worksheet #1). The stripmine portion of the site is located on a northwardly dipping Alluvial plate whose upgradient drainage area is estimated to be 14.23 acres (4; worksheet #1). Surface runoff from the 59.1 acre portion proceeds overland and along minor drainages eastwardly (3;frame,#16') until encountering a well-defined drainage which trends southeastwardly,(3;frame #17,#18). Surface runoff from the 14.23 acre portion proceeds overland and along minor drainages eastnortheastwardly (3;frame#31) until encountering the well-defined drainage which trends southeastwardly (7). The drainage proceeds southeastwardly for approximately 4 mi. before becoming evanescent (7, 31). Data from a gauging station on the Rio San Jose at Grants, New Mexico indicates an

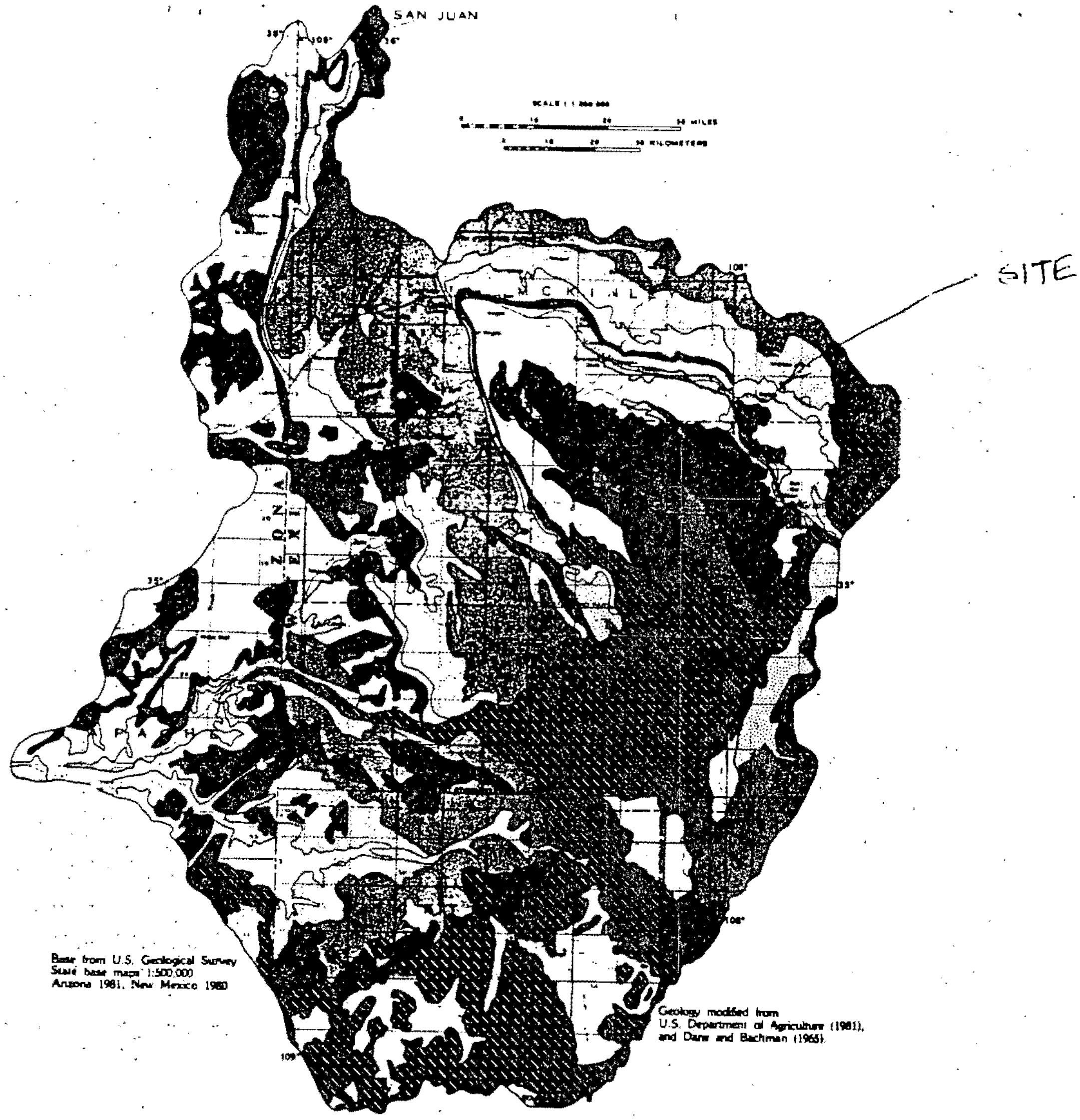


Figure 2.6-1 Generalized geologic map.

EXPLANATION

QUATERNARY AND TERTIARY	ALLUVIUM AND BOLSON DEPOSITS
	IGNEOUS ROCKS, INCLUDES BASALT FLOWS, VOLCANIC BRECCIA, TUFF AND CINDERS, AND EXPOSED INTRUSIVE IGNEOUS ROCKS
TERTIARY	SEDIMENTARY ROCKS INCLUDING BIDAHOCHI FORMATION, CHUSKA SANDSTONE, AND BACA FORMATION
CRETACEOUS	MESAVERDE GROUP
	MANCOS SHALE AND DAKOTA SANDSTONE, UNDIVIDED
JURASSIC	MORRISON FORMATION, ZUNI SANDSTONE, AND SAN RAFAEL GROUP, UNDIVIDED
JURASSIC AND TRIASSIC	GLEN CANYON GROUP
TRIASSIC	CHINLE FORMATION; LOCALLY INCLUDES MOENKOPI FORMATION
PERMIAN	SAN ANDRES LIMESTONE AND GLORIETA SANDSTONE IN NEW MEXICO, DE CHELLY SANDSTONE IN ARIZONA, AND THE YESO AND ABO FORMATIONS IN NEW MEXICO
PERMIAN AND PENNSYLVANIAN	SUPAI FORMATION
PRECAMBRIAN	PRECAMBRIAN ROCKS, UNDIVIDED

FIGURE # 3 ; REGIONAL GEOLOGY,
AFTER USGS, HYDROLOGY OF REGION 62

NAVAJO SUPERFUND OFFICE

NAVAJO-BROWN VANDEVER URANIUM MINE

JUNE, '90 P. MOLLOY

annual discharge rate of 2.97 cfs (20). The regional 1-yr, 24-hr rainfall event for the locale is 1.26 inches (13). Radioactive and toxic heavy metal species have been shown to be mobile in surface waters (23 throught 29). In particular, Arsenic and Selenium are known to sorb strongly to surface water sediments (26,28). The possibility exists for contaminated sediments to have been carried by flash floods, over the decades, onto the Alluvial plain east of El Tintero cinder cone (figure #2,7). A slight possiblilty exists for contaminated sediments to have been carried into Bluewater creek and the Rio San Jose (5,7). The area has not been mapped in a flood plain, However, due to the arid nature of the upgradient terrain and the general topography, the locale is prone to flash flooding events. Moreover, Haystack Mountain is very likely to be a recharge zone for aquifers in the area (5;pg#38).

D. ON SITE PATHWAY

As with other mines in the area the proto-ore was abandoned on-site. In the case of the Brown Vandever Mine, some of it was used to pave a haulage road which is used by site residents frequently (3;frame#22). The Brown Vandever mine environs are readily accessible by site residents and visitors to the area (3). There are no access barriers or danger signs on or near the mine site (3). Direct contact with contaminated particulates is possible during periods of high winds or physical disturbance of the tailings material. Humans living on-site and visitors to the area would are at risk to exposure from the same suite of radiospecies and heavy metals detailed above. Moreover, the ventilation shafts, the almost vertical timbered shaft and the inclined adits pose physical danger immediately dangerous to life and health status.

5. TARGETS

GROUND WATER TARGETS. There are three active wells within the 4 mile radius of influence of the site (19,21). The Indian Health Service (IHS) completed installation of a community Water System in October 1986 (21). Subsequent to the completion of the water system, operation and maintenance of the system was turned over to the Navajo Nation and is currently under the purvue of NNWRD (19). The community water system utilizes well #16T-551 which was formerly a livestock water well. The water system serves approximately 430 persons in the Haystack area (4;worksheet #2). Total population within the four mile radius of influence of the site was estimated to be approximately 500 (4;worksheet#2): The percentage of area residents not connected to the NNWRD water system was estimated to be 23% (=100 persons) on the basis of a residence count and the fact that 43.8% of Indian homes had their source of water more than 100 yds from their residence (3,18,31). Area residents too indigent to afford plumbing and sewerage systems for their residences might utilize water from the active NNWRD stockwells #16T-522 and # 16T-521 (19,3;frame#41,18;pg.#1). In addition, there is at least 1 artesian spring in the immediate vicinity of the site (7;Bluewater Quad, 3;frame #35). There is a slight possibility that this spring could be utilized for drinking water.

The Aquifer of concern in the area is the Entrada sandstone unit which sources windmills possibly utilized for potable water by as many as 100 persons (4;worksheet#2,18;pg.#1,3;frame#41). Depth to the water table in this confined unit is reported to be approximately 400 feet (19). As pointed out before, the shaft and inclines have been driven to within 100 feet of this aquifer. Targets in the area consuming groundwater from the Entrada sandstone unit are at risk to exposure from Radionucleides and heavy metals (II).

SURFACE WATER TARGETS Surface water targets would be potentially exposed to the same suite of Radionucleides and heavy metals that is the case with ground water targets. Risk of exposure may be low due to the low value for net precipitation for the area. However, extreme conditions brought in the area would inundate the highly eroded haulage road (18).

The well-defined drainage coursing first east and then southeast from the site crosses at least one federally designated wetland (9).

AIR TARGETS Humans living on site are being exposed to elevated Radon concentrations.

ON-SITE TARGETS In addition to being exposed to elevated Radon concentrations, residents of the Brown Vandever mine environs are confronted daily with the dangerous inclines, shafts and the insult to their land.

SENSITIVE ENVIRONMENTS At least one federally designated sensitive environment lies within 1 mile of the site.

6. OTHER REGULATORY INVOLVEMENT

PERMITS: No permit was found for the Brown Vandever Uranium mine

STATE AGENCIES: None

OTHER FEDERAL PROGRAMS: None

7. CONCLUSIONS AND RECOMMENDATIONS

The Brown Vandever Uranium mine site is exceptionally dangerous. However, no steps toward remediation or mitigation have been undertaken over the two and one half decades since cessation of activities. To assert that residents of the site have not been adversely affected by the insult to their land and very possibly their health is inadmissable.

Immediate action should be taken.

Reference List

Reference No.

1. Molloy, P., February 26, 1990. EPA Potential Hazardous Waste Site Identification for Brown (sic) Uranium Mine, Bluewater, NM

2. New Mexico Bureau of Mines, 1983. Open file report OFR - 183. Uranium and Thorium occurrences in New Mexico: Distribution, Geology, Production and Resources.

3. Molloy P., April, 1990. Population, Population distribution, water usage and radiation survey for Haystack community.

4. Molloy, P., May, 1990. Mine Spoils calculations for the Brown Vandever Uranium Mine; worksheet for upgradient drainage area calculation; worksheet for population estimate.

5. United States Geological survey (USGS), April, 1984. Hydrology of area 62, Northern Great Plains and Rocky Mountain Coal Provinces, Colorado and New Mexico (open-file Report 83-698). Excerpts.

6. New Mexico Bureau of Mines and Mineral Resources, 1974. Geologic Map of Grants Uranium Region.

7. USGS 7.5 Minutes Topographic Maps: Bluewater Quadrangle, 1957; Ambrosia Lake Quadrangle, 1957; Goat Mountain Quadrangle, 1957; Prewitt Quadrangle, 1963; Thoreau NE Quadrangle, 1963; Dos Lomas Quadrangle, 1957.

8. New Mexico Geological Society, 1977. Guidebook of San Juan Basin III: Stratigraphic nomenclature chart and Haystack environs field notes (Excerpts).

9 US Fish and Wildlife, 1984. National Wetlands Inventory for Grants, New Mexico.

10. De Voto, Richard H. March, 1978. Uranium Geology and Exploration; Colorado School of Mines, Golden Colorado

11. Hilpert, Lowell S., 1969. Uranium Resources of Northwestern New Mexico (Geological Survey Professional Paper 603).

12. Becker, Dr. Robert, 1985. Preliminary Average Annual Lake Evaporation for the Navajo Reservation in inches of Water.

13. 40 CFR Parts 190 to 399, July, 1987. Protection of the Environment; 1-year 24-Hour Rainfall (inches).

14. Molloy, P., April 11, 1990. Field Notes for Haystack Community Field Reconnaissance.

15. Eberline, December, 1987. Radiation Protection Catalog; Instrumentation specification Excerpts.

16. Contact Report, May 10, 1990. To; Mike Holona, Ranger, Navajo Fish and Wildlife. From; Patrick Molloy, Health Physicist, Navajo Superfund Office. Re; Fisheries, Hunt Units and Recreational areas in Haystack Mountain Area.

17. Contact Report, 1989. To: Rich Koch, Geologist, Navajo Nation Minerals Department. From; Patrick Molloy, Navajo Superfund Department. Re; Leases-Navajo Lands Uranium Mines.

18. Molloy, P., May, 1990. Field Notes for Haystack Community Reconnaissance.

19. Navajo Nation Water Resources Division, Various Dates. Pertinent Excerpts from NNWRD Water Well Records.

20. US Geological Survey Waterdata Report NM-88-1, 1988. Water Resources Data for the Rio San Jose at Grants, New Mexico.

21. US Department of Health, Education and Welfare, Indian health Service, June, 1978. "As Built" Water System for Haystack, Navajo Nation, New Mexico.

22. CRC Press, 1989. Handbook of Chemistry and Physics.

23. The Merck Index, Tenth Edition, 1983. Windholz, W. ed., Merck and company Inc., Rathway, N.J.

24. Groundwater Prospecting for Sandstone-Type Uranium Deposits: A Preliminary Comparison of the Merits of Mineral-Solutions Equilibria, and Single-Element Tracer Methods, D. Langmuir and J.R. Chetham, May 1980.

25. The Thermodynamic Properties of Radium, Donald Langmuir, Department of Chemistry and Geochemistry, Colorado School of Mines, Golden Colorado, and Riese, Arthur C., Atlantic Richfield Company, Corporate Technology, Los Angeles, CA., April 1985.

26. Geochemistry of Selenium: Formation of Ferroselite and Selenium Behavior in the Vicinity of Oxidizing Sulfide and Uranium Deposits, Howard, J. Hatten, III., Department of Geology, University of Georgia, Athens, GA., July 1977

27. The Mobility of Thorium in Natural Waters at Low Temperatures, Langmuir, Donald, Department of Chemistry and Geochemistry, Colorado School of Mines, Golden, CO., and Herman, Janet S., Department of Geosciences, The Pennsylvania State University, University Park, PA., July 1980.

28. Agency for Toxic Substances and Disease registry (ATSDR) US

Public Health Service, March, 1990. Toxicological Profile for Arsenic (EXCERPTS).

29. ATSDR, Public Health Services, July 1989. Toxicological Profile for Chromium (Excerpts).

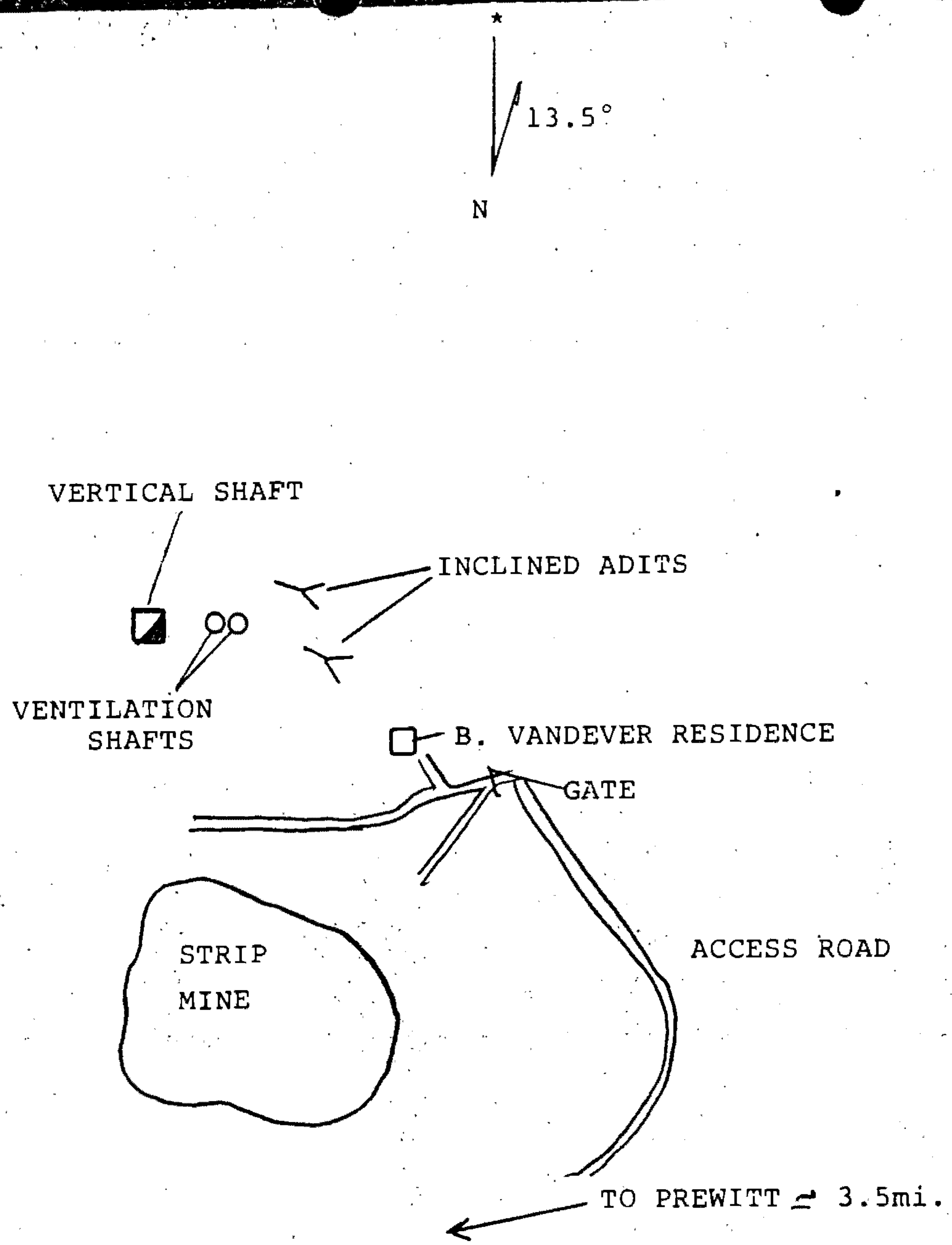
30. New Mexico Bureau of Mines and Mineral Resources, 1979. Open File Report OFR - 90. Descriptions of sections measured for Hydrogeologic study of the San Juan Basin, Northwest New Mexico

31. Navajo Nation, 1988. Navajo Nation Fax'88: A Statistical Abstract. Prepared by Technical Support Department, Window Rock, Navajo Nation, Arizona 86515.

32. Thaden, Robert E. and Ostling, Earl J. 1967. Geologic map of the Bluewater Quadrangle, Valencia and McKinley Counties, New Mexico.

33. US EPA, 1984. Uncontrolled Hazardous Waste Site Ranking System, Users Manual (HW-10).

34. Contact Report, May 29, 1990. To; Patrick Antonio, NSO Staff Hydrogeologist. From; Patrick Molloy, NSO staff Health Physicist. Re; Influence of faults in the Haystack area on Groundwater Hydrogeology (considered opinion).



SCALE - 1" ≃ 1418 ft.

FIGURE # 4 ; SITE SKETCH

NAVAJO SUPERFUND OFFICE

NAVAJO-BROWN VANDEVER URANIUM MINE SITE SKETCH

JUNE, '90 P. MOLLOY

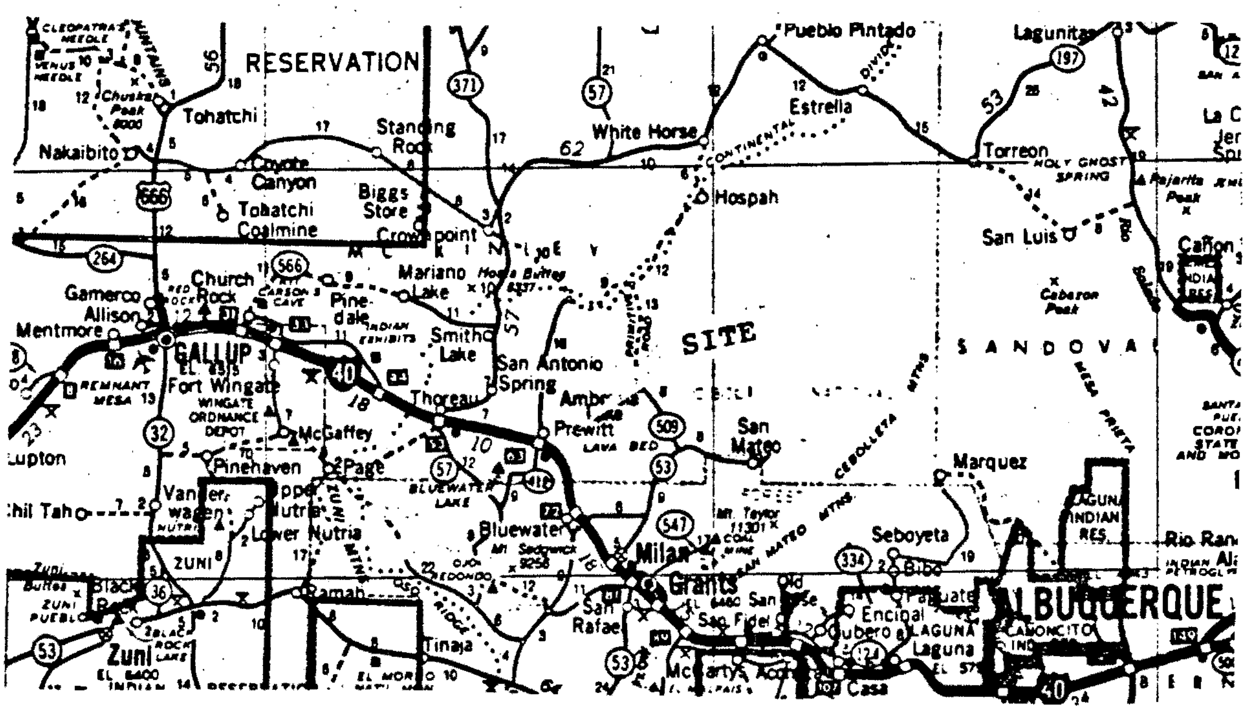


FIGURE # 1 ; REPRINTED BY PERMISSION

NAVAJO SUPERFUND OFFICE

NAVAJO-BROWN VANDEVER URANIUM MINE

JUNE, '90 P. MOLLOY

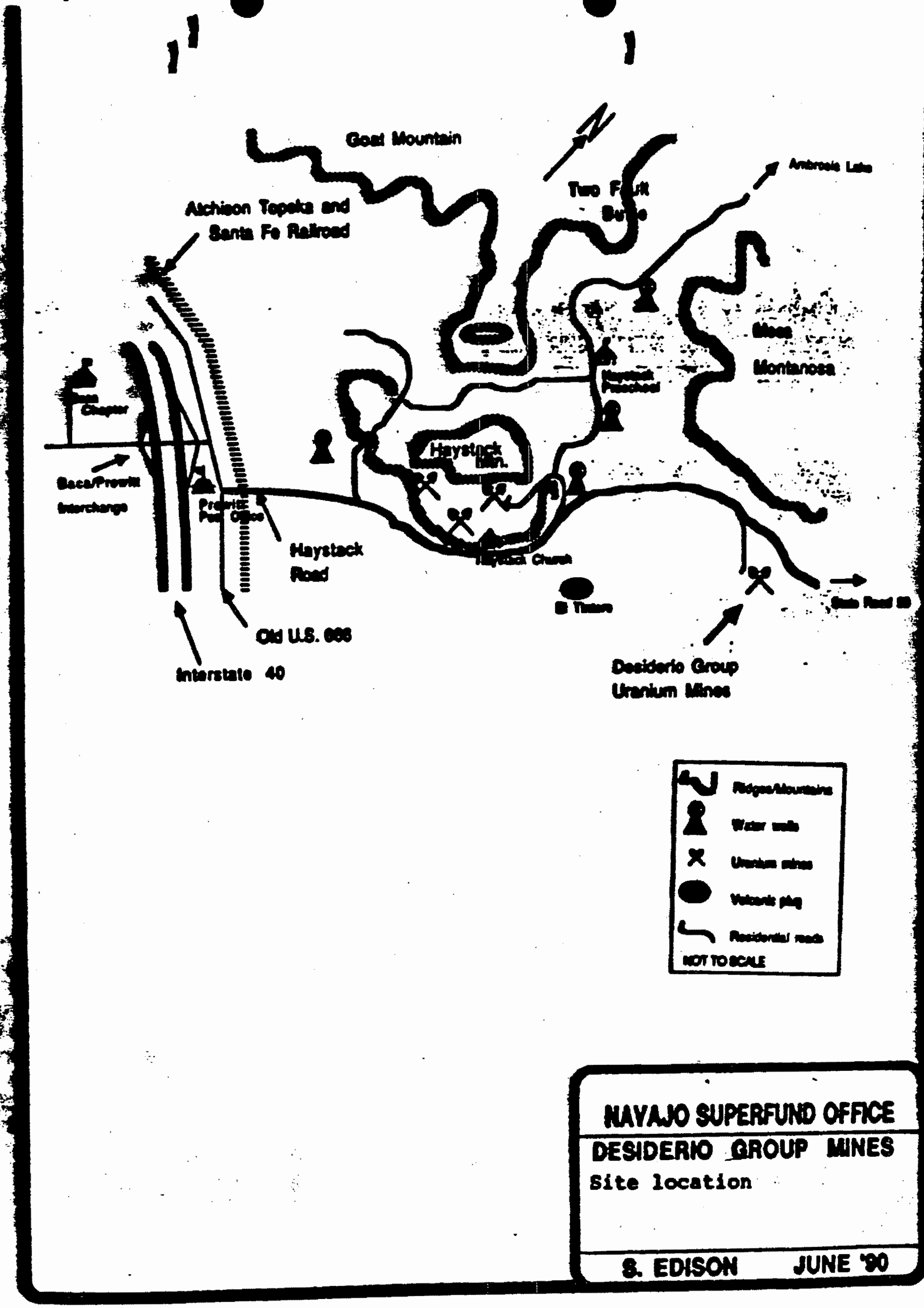
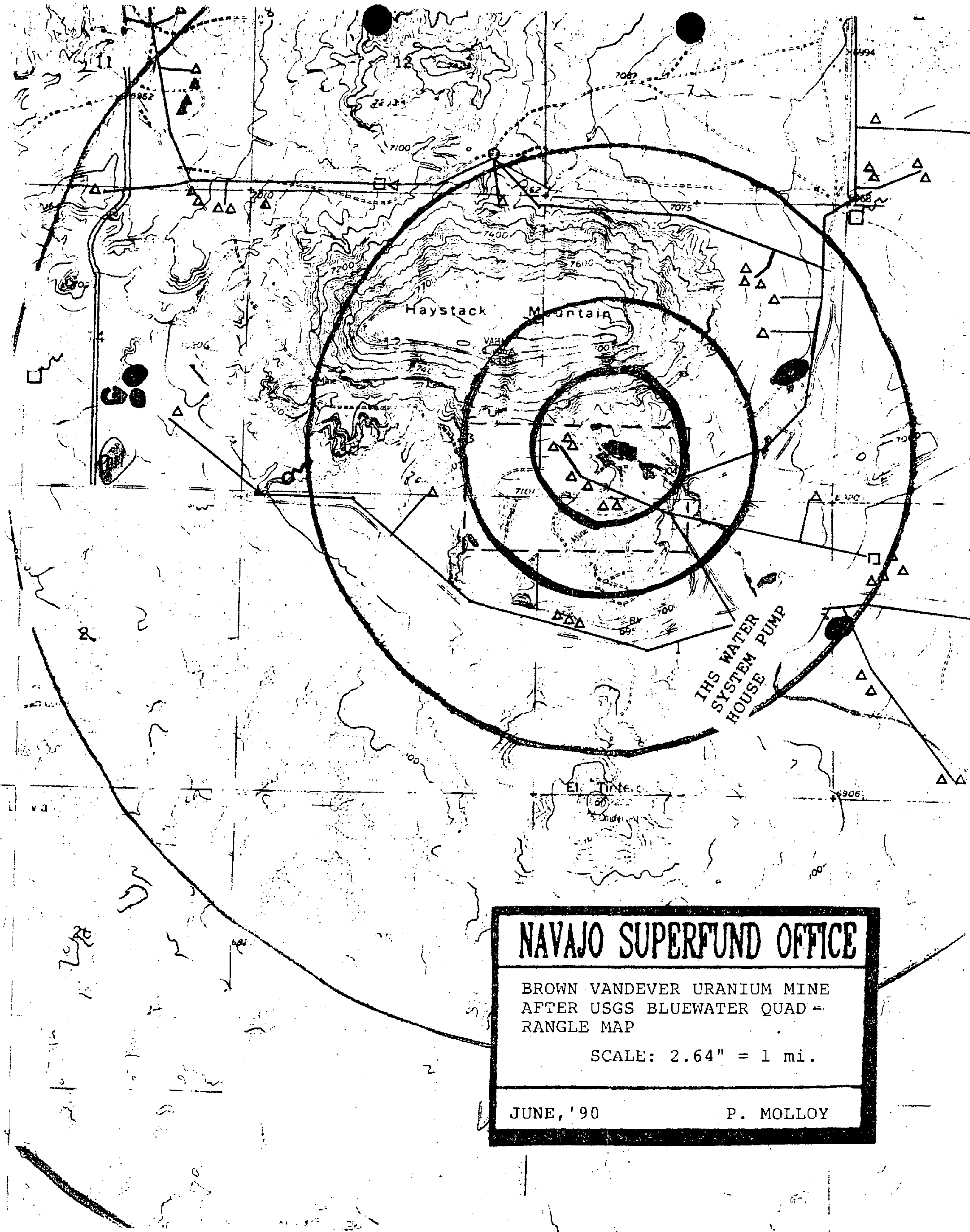

Goat Mountain
Ambrosia Lake
Atchison Topeka and Santa Fe Railroad
Mesa Montanosa
Chapter
Baca/Prewitt Interchange
Haystack Mtn.
Haystack Road
Haystack Church
Old U.S. 666
Interstate 40
Desiderio Group Uranium Mines
Ridges/Mountains
Water wells
Uranium mines
Volcanic plug
Residential roads
NOT TO SCALE
NAVAJO SUPERFUND OFFICE
DESIDERIO GROUP MINES
Site location
S. EDISON
JUNE '90

Figure 3


Haystack Mountain
IHS WATER SYSTEM PUMP HOUSE
El Tinte
NAVAJO SUPERFUND OFFICE
BROWN VANDEVER URANIUM MINE AFTER USGS BLUEWATER QUAD-RANGLE MAP
SCALE: 2.64" = 1 mi.
JUNE,'90
P. MOLLOY

AJ → MA

LEONARD HASKIE
INTERIM PRESIDENT
NAVAJO NATION

THE NAVAJO NATION

IRVING BILLY
INTERIM VICE PRESIDENT
NAVAJO NATION

NSO-90-93

August 1, 1990

Mark Satterwhite
Superfund Indian Coordinator
U.S. EPA Region VI
1445 Ross Avenue
Dallas, Texas 75202

Dear Mr. Satterwhite:

Enclosed is the Preliminary Assessment (PA) Package for the Navajo-Desiderio Group Uranium Mines, located near Haystack, New Mexico. This report receives NSO internal approval and is now ready for your review and comment.

Please call myself or Stanley Edison, the Chemist who prepared the package, for any questions you may have regarding the report. We would appreciate a response in the form of comments or approval at your earliest convenience. You may reach myself or staff at (602) 871-6859, 6860 or 6861.

Sincerely,

Clara Bia
Navajo Superfund Director

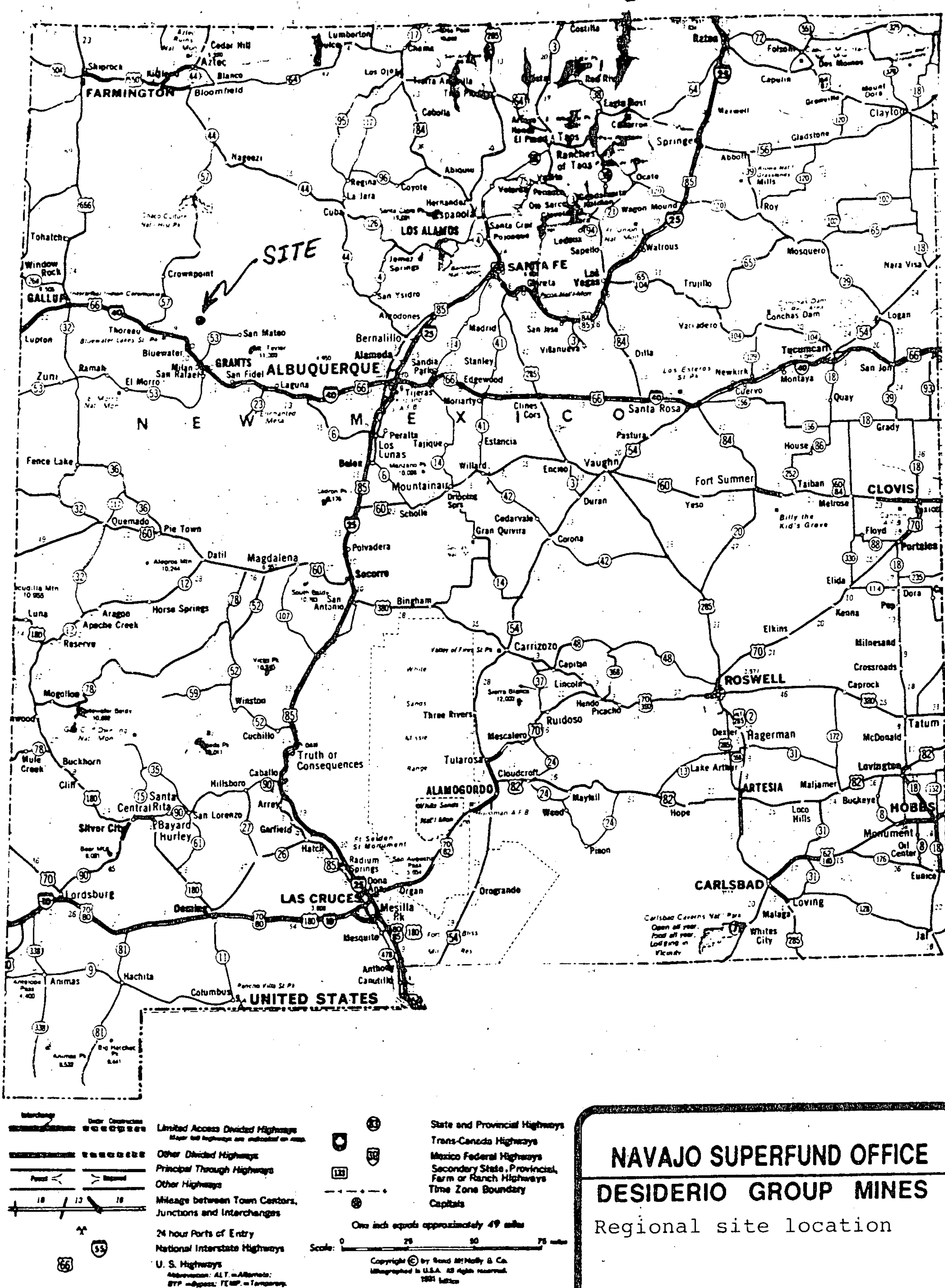
Enclosures

cc: Peter Sam, William Taylor, Superfund Site Assessment Section
Barbara Driscoll

PRELIMINARY ASSESSMENT NARRATIVE

NAVAJO-DESIDERIO GROUP

URANIUM MINES



NAVAJO SUPERFUND OFFICE

DESIDERIO GROUP MINES

Regional site location

S. EDISON JUNE '90

Figure 2 After Diamond Shamrock Highway of NM 1981
Ran McNally & Co.

Preliminary Assessment

Date : July 30, 1990

Prepared By : Stanley Edison, Chemist
Navajo Superfund Office
P.O. Box 2946
Window Rock, Arizona 86515

Site: : Navajo - Desiderio Group Uranium Mines
Ambrosia Lake Subdistrict
Grants Uranium District

EPA ID #:

1. Site Information

a. Site Location. The Desiderio Group Uranium Mines, also known as the Hanosh Mines Section 26, are located in the Ambrosia Lake Subdistrict of the Grants Uranium Mining District (Figure 1). The abandoned uranium mines are located approximately 9 miles east of Prewitt, New Mexico and 3 miles west of State Highway 53 in McKinley County, NM (Figure 2). The geographic coordinates of the site are 35o20'00'' north latitude and 107o51'30'' west longitude (1,3). The site can found by proceeding 1 mile southeast of the Prewitt Post Office on old US Highway 66, turn left onto Haystack Road and proceed for about 9 miles to the Jenny Desiderio residences (Figure 3). The uranium mines are located directly adjacent to the residences (Photographs).

The site occupies approximately 130 acres of semi-agricultural lands (9). The site also partially extends into the adjacent Sections 23 and 25 (1). The site consists of a 155 feet inclined adit, open pit mines and numerous mine waste dumps (3,9,Photographs).

b. Owner/Operator. The site is located on Navajo Allotted Lands (23,24). The original allottee has deceased and the heirs to the land are the spouse Mrs. Jenny Desiderio and children (8). The land is held in trust for the heirs by the United States Government thorough the authority of the Bureau of Indian Affairs (BIA) (8). The heirs never operated the uranium mines.

The uranium mines were operated by "Santa Fe" and the Hanosh Mines of Grants, NM (5). Uranium mining started in 1952 and terminated in 1957 (2,3). The mine operators negotiated a lease agreement and presumably received a mining permit from the BIA to mine the claim (30).

c. Purpose for Investigation. The Desiderio Group Uranium Mines were reported to be a potentially contaminated hazardous waste site by the Baca Chapter in January 1990 (9). The Baca Chapter is a local community government oversees the community's needs and resources.

2. Background/Operating History

a. Site History. The ore, present as carnotite and tyuyamunite was removed from the host limestone rock (Jurassic) by conventional mining methods of drilling and blasting (2,3,5). The surface overburden was stripped away by heavy machinery such front end loaders and bull dozers to extract the ore. The high grade ore was loaded onto ore trucks for transportation to a local uranium milling and processing plant. The inclined adit was created by rotary drilling with limited blasting. The ore from the adit was transported to the surface via ore carts on railroad tracks. Low grade ore along with the tooled mine waste was disposed of on-site while the high grade ore transported to the Anaconda Minerals Company located about 6 miles southwest of the site (5).

A total of 11,110 tons of ore was reported to have been removed for the mines from 1952 to 1957. Approximately, 83,752 pounds of U308 and 17,518 pounds of V205 were milled from this production volume (2,3).

b. Known/Potential Problems. The mine waste piles and the exposed surface pits have the potential of producing leachate rich in toxic heavy metals and radioactive contaminants. Contamination of ground water and surface water could result from the migration of leachated into these systems (6).

The open pit mines provide large water impoundments after precipitation events which are utilized by the on-site livestock as a water source. After surface water utilization, the livestock have been observed to be lethargic, have weight loss, hair/wool loss and death eventually follows. The on-site residents have ceased to depend on their livestock as a food source after observing these symptoms (5).

The site is unfenced, the mines are readily accessible leading to persistent visits by on-site residents and their livestock (9,Photographs). The residents are potentially exposed to ionizing radiation and inhalation of Radon, a radioactive gas associated with uranium ore (22,33). Uranium salts are very toxic compounds to humans (25). It is a noted persistent compound that can remain radioactive for years. Vanadium oxides are also very toxic compounds for humans (25). There are high possibilities for the off-site migration of radioactive contaminated particulates from the mine waste dumps.

There was a fatal accident that occurred in the winter of 1979. An on-site resident was fatally injured after he apparently fell into a near by open pit mine. The injured party was taken to a hospital in Albuquerque, NM where death occurred (5).

There are no documentation concerning remedial action of the Desiderio Group Uranium Mines.

3. Waste Containment/Hazardous Substance Identification

a. Waste Generation. A calculated volume of 319[illegible] cubic yards of low grade radioactive uranium ore and tooled mine waste are present on-site (7). These materials are exposed, uncontained, unlined and capable of producing leachated subject to migration into the atmosphere, ground water and surface water systems (6). The exposed surface of the adit and surface pits may also be producing leachated similar in composition to that released from the mine waste piles.

Specific radioactive species which may be contributing to the leachated are Uranium and its daughter products, Radium, Thorium, Racon and isotopes of Lead and Bismuth (14,33). The entire site may emit significant concentration of Radon gas, a toxic decay product of uranium ore (22). Toxic heavy metals species suspected in mine waste piles are Arsenic, Selenium, Lead and Vanadium (14,33). Table 1 provides a summary of the hazardous substances potentially present in the mine waste piles and on exposed surfaces of the mines.

4. Pathway Characteristics

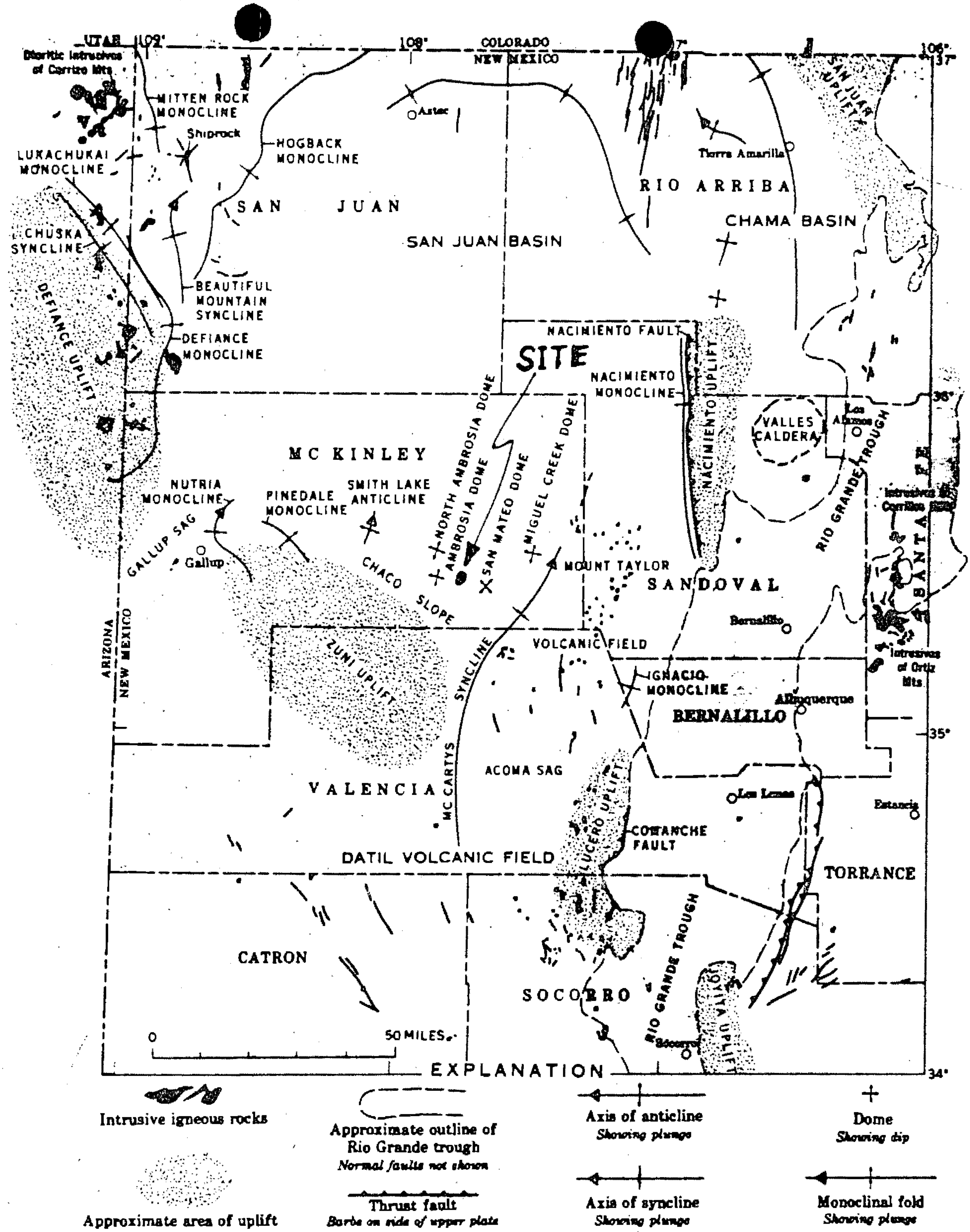
a. Air Characteristics. The potential migration of particulates of hazardous and toxic compounds associated with uranium mine waste piles are high due seasonal high winds and anthropogenic activity. The potential gas mobility of Radon, a dangerous radioactive gas is also high due to areal extent of uranium mine workings (22).

b. Ground Water Characteristics. The uranium mines are regionally located at the southern edge of the Colorado Plateau. The site is bounded to the east by the volcanic fields of Mt. Taylor, to the west and to the south by the Zuni Uplifts (Figure 4). The land is characterized by broad open valleys and mesas (1). Locally, the mines are driven into the Todlito Limestone (ls), (Jurassic) with some surrounding Quaternary Alluvial deposits (Pleistocene) (10). The ls units are sloping gently eastward into a prominent tributary basin (1). This tributary flows south for approximately 1 mile before reaching a stock reservoir (1).

The aquifer of concern is the Entrada Sandstone (ss) underlying the Todlito ls (10,12,20). The Todlito ls about 25 to 35 feet thick and the Entrada ss is approximately 120 to 185 feet thick (10,20). The Entrada ss is composed of sandstone and some siltstone which yields small amounts of water to area wells (11,12). The water wells sourced by the Entrada ss are 16B-38 and 16T-521 designated for domestic and livestock use (1,12,20). The approximate hydraulic conductivity for the Entrada ss is 10-3 to 10-5 centimeter per second (18). There is a Public Water System (PWS) water well 16T-551 which is sourced by a deeper Sonsela ss member of the Chinle Formation (Triassic) (12,27). Other wells within the four miles of concern of the site are located downgradient and are sourced by the ss units of the Chinle Formation (1,12). These water wells are located outside Navajo allotted land and on private lands. According to the United States Geological Society water well records, a rancher downgradient of

TABLE 1. Hazardous Waste Disposal on-site at the Desiderio Group Uranium Mines

Hazardous Waste	Quantity of Mine Waste	Quantity of Hazardous Waste	Disposal Location	Origination
1. U308	Estimated mine waste volume of 91,962 cubic yds. contains the listed hazardous waste.	91,962 cubic yds.	On-site	Low grade uranium ore
2. V2O5				
3. Radium				
4. Thorium				
5. Arsenic				
6. Selenium				
7. Lead				
8. Radon				



NAVAJO SUPERFUND OFFICE

DESIDERIO GROUP MINES

Regional geology

S. EDISON **JUNE '90**

Figure 4 After Hilpert, L.S. Ref. 14

[illegible] site reported some of his cattle died after [illegible] water from well 00-3340. This water well is sourced by the ss units of the Chinle Formation (12).

As discussed above, contaminates of concern present in the mine waste are Uranium, Radium, Thorium, Vanadium, Arsenic, Lead and Selenium (14). All of these species have been demonstrated by various investigators to be mobile in waters associated with uranium mining (16,26). There are high possibilities that these radioactive and toxic heavy metal species have leached into the Entrada ss aquifer serving two wells designated for domestic and livestock use (12). There is also the possibility of cross contamination via aquifer interconnection between the Entrada and Sonsela aquifers. Migration of contaminants into aquifers deeper than the Entrada ss is a high possibility since the incline adit and the open pit mines penetrate the surface to a depth of more than 50 feet (3). This potential may be limited be a net precipitation for the area of minus 33 inches per year (4).

c. Surface Water Characteristics. The inclined adit and the open pit mines are located on a moderately dipping plain which drains an estimated 69.8 acres of immediate upgradient surface area (13). There are small tributaries course into the open pit mines and from mine waste piles. The site drainage empties into a prominent tributary that flows directly into a stock reservoir located about 1 mile south of the site (1,9). The drainage for the reservoir is not defined but is presumed to fan out onto the alluvial plains area (1,9,10).

The site has not been mapped in a flood plain. The two-year twenty-four hour rainfall event for the area is 1.2 inches (15).

Radioactive and toxic heavy metals species associated with the uranium mine waste piles have been shown to be mobile in oxidizing aqueous environments like surface waters (16,26). Thus, the possibility exist for radioactive contamination of surface water impoundments and surface water runoffs.

d. On-Site Pathway Characteristics. The open pit mines are unfenced and the mine waste piles are readily accessible to on-site residents (9,Photographs). The inclined adit is not barricaded and is accessible to young children known to play in the area (9,Photographs). There is a possibility of direct contact or exposure through ingestion of wind blown [illegible] contaminated with radioactive and heavy metal species. In addition, Radon gas emissions and ionizing radiation may be significant from the mined areas (22,25). The [illegible] residents are located less than 200 feet from the nearest radioactive mine waste pile (9,Figure 4,Photograph 3).

5. Targets

a. Ground Water Targets. There are 86 residences with a population equivalent of 442 in the Haystack community that are served by the PWS water well 16T-551, operated by the Navajo Tribal Utility Authority (27,29). The PWS well is located about 3.7 miles westnorthwest of the site (1). Depth to the Sonsela aquifer, a member Chinle Formation sourcing this well is at least 1555 feet (12).

Targets in the area consuming ground water possibly contaminated by leachate from the site mine waste would face exposure to the following: Uranium, Radium, Thorium, Radon, and isotopes of Lead and Bismuth (6,14,33). Toxic heavy metals such as Arsenic, Lead, Selenium and Vanadium are also subject to leaching from the mine waste piles (6,14,33). A preliminary study of birth defects among Navajo Indians exposed to water supplies associated with ore bodies suggests that ground water contamination by mine waste leachate may pose a significant threat to the health and safety of water consuming individuals (32).

b. Surface Water Targets. Surface water targets would be potentially exposed to the same suite of radionuclides and toxic heavy metals to which ground water targets are potentially exposed. Risk to exposure may be low due to the arid climate of the region (4,15). However, on-site livestock utilizing surface water impounded by the surface pits have led to livestock poisoning and fatalities (5). Studies of livestock grazing in a similar uranium mining area indicates bioaccumulation of several radioactive species that may have been made available by ingestion of surface waters (31).

There is no definable surface water pattern beyond the stock reservoir located one mile south of the site (1,9). It is assumed that surface water drainage beyond the reservoir will fan out onto the alluvial plains (1,9). Under further assumption, there are no surface waters with one mile of the site that are designated for fishing or other surface water recreation activity (1,9).

c. Air Targets. On-site residents and livestock frequenting the site are at risk of exposure to ionizing radiation and potential ingestion of contaminated particulates mobilized as windblown materials (5,25). They may also be exposed to Radon gas.

d. On-Site Targets. The on-site population consist of 21 persons (1,9,19). The nearest single family residence is located approximately 0.5 mile west of the uranium mines (1). The on-site residents frequent the site to gather grazing livestock, disposed of domestic trash into the open pits and younger children recreate on the waste piles and in the open pit mines.

e. Sensitive Environments. There are no confirmed sensitive environments within one mile of the Desiderio Group Uranium Mines (21). The Navajo Fish and Wildlife indicates that all of the Navajo allotted lands are largely unsurveyed Threatened and Endangered Species (17).

6. Other Regulatory Involvement

a. Permits. No permit for Uranium mining operations are presently known to exist for the site. The BIA is presumed to have issued a lease agreement or a mining permit to the operators of the mines in 1952 (30).

b. State Agencies. The Navajo Abandoned Mine Lands Program receives money from the Office of Surface Mining, a branch of US Dept. of Interior, for various kinds of cleanup of abandoned Coal mines and in some states, Uranium mines worked before 1977. This money is federally available to a designated group of 26 states and Indian tribes through the Surface Mining Control and Reclamation Act. Navajo AML has inventoried and investigated many abandoned uranium mines on the Navajo Nation, however jurisdiction on Navajo allotted Lands is not claimed.

c. Federal Programs. See part b. above.

d. Removal Considerations. Mine waste piles contributing to the release of contaminants to the environment should be removed or permanently covered to prevent radiation and leaching. Barriers to the accessibility to open pit mines, inclined adit and mine waste piles should be constructed to reduce risk of exposure to ionizing radiation and ingestion of radioactive particulates present as windblown material.

Conclusions

The Desiderio Group Uranium Mines occupies about 130 acres of Navajo allotted, semi-agricultural lands located 9 miles east of the Prewitt NM. All Navajo allotted lands are under to BIA jurisdiction. The BIA may have approved the lease agreement between the mining companies and the land owner. The mining operations started in 1952 and continued until abandonment in 1957. Approximately 11,110 tons of ore was removed from the mines and transported to the Anaconda Minerals Company located about 6 miles southwest of the site. Low grade ore and tooled mine waste were disposed of on-site adjacent to the Desiderio residences. Currently, the mine waste piles, an inclined adit and open pit mines are not fenced or barricaded to prevent access by on-site residents and their livestock.

There is a high potential for ground water and surface water contamination. The radioactive contamination is a result of past uranium mining activities. The mines are driven into the Todilto limestone to a depth of more than 50 feet and the underlying Entrada sandstone sources two water wells designated as domestic and livestock use. There is a high potential for leachate contamination of the Entrada and the Sonsela aquifers via aquifer interconnection. There are open pit mines that provide large surface water impoundment after precipitation events. Livestock has utilized the impounded surface waters and has resulted in sickness and death. The soil surrounding the mines are contaminated by low grade uranium ore abandoned after the mining ceased. The persistent nature of radioactive and heavy metal species, suggests that on-site exposure is potentially very high.

The uranium mines were abandoned and never operated after 1957. The mines are in close vicinity to the residential area which allows for the opportunity of constant exposure to ionizing radiation and ingestion of particulate contaminated with radioactive and heavy metals species.

REFERENCES

Reference Number	Reference
1.	USGS 7.5 Minute Topographic Maps: Dos Lomas, NM 1957; Blue Water, NM 1957; Ambrosia Lake, NM 1957; Goat Mountain, NM 1957 Chuska Lake, NM 1970.
2.	Mclemore, V.T., Septemember 1983. "Uranium and Thorium Occurrences in New Mexico: Distribution, Geology, Production, and Resources, with Selected Bibliography". New Mexico Bureau of Mines and Mineral Resources Open-file Report OF-183.
3.	Mclemore, V.T., Septemember 1983. "Uranium and Thorium Occurrenes in New Mexico: Appendix 1". New Mexico Bureau of Mines and Mineral Resources Open-file Report OF-183.
4.	Contact Report, June 7, 1990. To: Robert Becker, Navajo Water Monitoring Inventory Program, Division of Natural Resource. From: Stanley Edison, NSO Chemist Re: Precipitation data for the Desiderio Group Uranium Mines
5.	Contact Report, March 23, 1990. To: Jenny Desiderio, On-site resident. From: Stanley Edison, NSO Chemist Re: History and Operations of the Desiderio Group Uranium Mines.
6.	Tso, H. and L.M. Sheilds, Volume 20. No. 1. June 1980. "Navajo Uranium Operations: Early Hazards and Recent Interventions". Reprinted from New Mexico Journal of Science.
7.	Worksheet # 1. June 29, 1990. Estimation of Hazardous Waste Quantity at the Desiderio Group Uranium Mines. Stanley Edison, NSO Chemist.
8.	Contact Report, May 24, 1990. To: Jerry DeGroat, BIA Crownpoint, NM. From: Stanley Edison, NSO Chemist Re: Desiderio allotment information
9.	Memo to File. June 29, 1990. To: Desiderio Group Uranium Mines file. From: Stanley Edison, NSO Chemist. Sub: Site Reconnaissance for Desiderio Group Uranium Mines
10.	Thaden, R.E. and E.S. Santos, 1967. "Geologic Map of the Dos Lomas Quadrangle, Valencia and Mckinley County, New Mexico". U.S. Geological Survey, Washington DC.
11.	Contact Report, March 20, 1990. To: Melvin Badonie, Navajo Water Development. From: Stanley Edison, NSO Chemist. Re: Navajo Nation District 16, Water Wells and Springs Map

12. Water Well Development, Navajo Tribe. Tribal Well Records for: 16B 38, 16T-551, 16T-521, 16T-586, 00-3289, 00-3322, 00-3323, 00-3326, 00-3332, 00-3334, 00-3334, 00-3336, 00-3340.

13. Worksheet #2, June 29, 1990. Estimation of the Upgradient Drainage Area for the Desiderio Group Uranium Mines. Stanley Edison, NSO Chemist.

14. Hilpert, L.S., 1969. "Uranium Resources of North Western New Mexico", Geological Survey Professional Paper 603. United State Government Printing Office, Washington.

15. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. National Weather Service, Office of Hydrology. "Isopluvials of 2-yrs 24-hr precipitation in tenths of an inch" Atlas 2, Volume IV

16. Langmuir, D. and J.R. Chatham, May 1980. "Groundwater Prospecting For Sandstone-Type Uranium Deposits: A Preliminary Comparison of the Merits of Mineral-Solution Equilibria, and Single-Element Tracer Methods". Journal of Geochemical Exploration, Volume 13 (1980) pp. 201-219.

17. Memo to File, June 29, 1990. To: Desiderio Group uranium mines file. From: Stanley Edison, NSO Chemist. Sub: Threatened and Endangered Species in the Desiderio Group Uranium Mines area.

18. United States Environmental Protection Agency, 1984. "Uncontrolled hazardous Waste Site Ranking System". A Users Manual (HW-10).

19. Navajo Nation, 1988. "Navajo Nation FAX '88, Summer of 1980 Census, Navajo Reservation Data", Prepared by Technical Support Dept., Commission for Accelerating Navajo Development Opportunities.

20. Cooley, M. E., J. W. Harshbarger, J. P. Akers, and W. F. Hardt, 1969. "Regional Hydrogeology of the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah", USGS Professional Paper 521-A, Washington, D.C.

21. US Fish and Wildlife Service, 1984. "National Wetlands Inventory, Grants, New Mexico", 1:100,000 Quad.

22. Furtado, V.C., 1983. "Sampling Airborne Radioactivity", Air Sampling Instruments for evaluation of atmospheric contaminants. 6th ed., American Conference of Governmental Industrial Hygienists Cincinnati, Ohio.

23. Luebben, T.E., S.K. Tomita, C.R. Ingram, J.A. Flynn-O'Brient, S.E. Borg and R.W. Hughes, General Editor. March 1987. Indians Lands and Natural Resources, American Training and Technical Assistance.

24. Memo to File, June 29, 1990. To: Desiderio Group uranium mines file. From: Stanley Edison, NSO Chemist. Sub: Navajo allotments

25. Sax, N. I., and R. J. Lewis, Jr., 1987. "Hawley's Condensed Chemical Dictionary", Eleventh Edition.

26. Langmuir, D. and J.S. Herman, July 1980. "The mobility of thorium in natural waters at low temperatures". Geochimica et Cosmochimica Acta. Volume 44, pp. 1753-1766.

27. Dept. of Health and Human Services, 1988. Public Health Service. Navajo Area Indian Service. "Report of Sanitary Survey of Public Water System. Haystack Community PWSID #NM-"0000245, FDS ID#80820594.

28. Memo to File, June 29, 1990. To: Desiderio Group uranium mines file. From: Stanley Edison, NSO Chemist. Sub: Population served by ground water in the Haystack Community

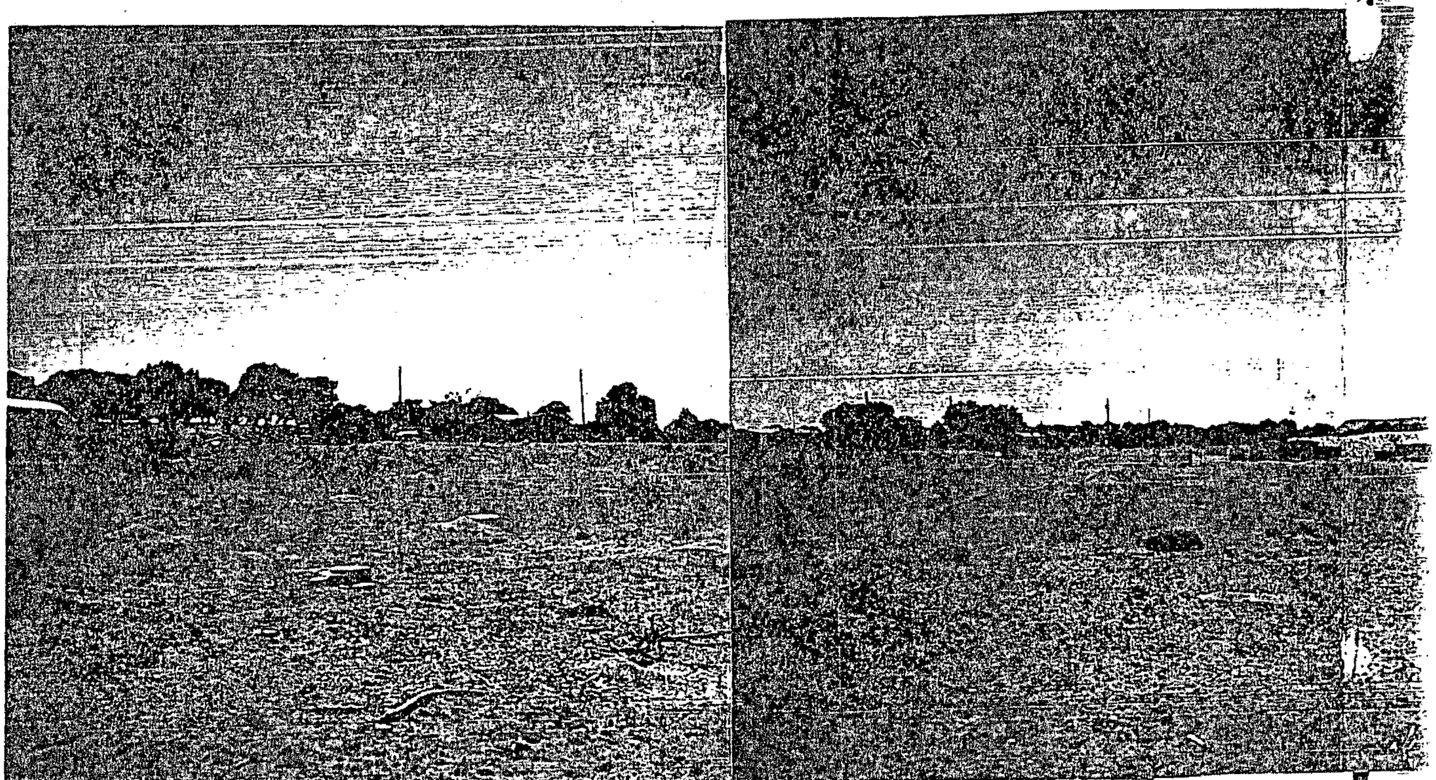
29. Contact Report, June 29, 1990. To: Victor Martinez, NTUA, Ft. Defiance, AZ. From: Stanley Edison, NSO Chemist. Re: AS-BUILT Map for Haystack Community Waterlines.

30. Contact Report. June 29, 1990. To: Ervin Mariano, BIA Window Rock, AZ. From: Stanley Edison, NSO Chemist Re: BIA Lease Agreements

31. Lapham, S.C., J.B. Millard and J.M. Samet, June 1986. "Radionuclide Levels In Cattle Raised Near Uranium Mines And Mills In Northwest New Mexico". P.O. Box 968, Santa Fe, New Mexico 87504-0968.

32. Shields, L.M. and A.B. Goodman. "Outcome of 13,330 Navajo Births from 1964 to 1981 in the Shiprock Uranium Mining Area". Navajo Community College, Shiprock, New Mexico 87420.

33. Tappen, J.T., January 1989. Health Physics Training for the Navajo Nation". ARIX Corporation, 760 Horizon Drive, Grand Junction, Colorado.



Photograph 1: The site photo is looking northwest, showing from (L to R), Desiderio [illegible] stock corrals near the mine waste [illegible] the entire Desiderio Group mines. The mines [illegible] not fenced leading to persistent visits by the [illegible] residents and their livestock. The background [illegible] of the Dos Lomas [illegible].

NAVAJO SUPERFUND OFFICE

DESIDERIO GROUP MINES

Photograph 1

S. EDISON **JUNE '90**

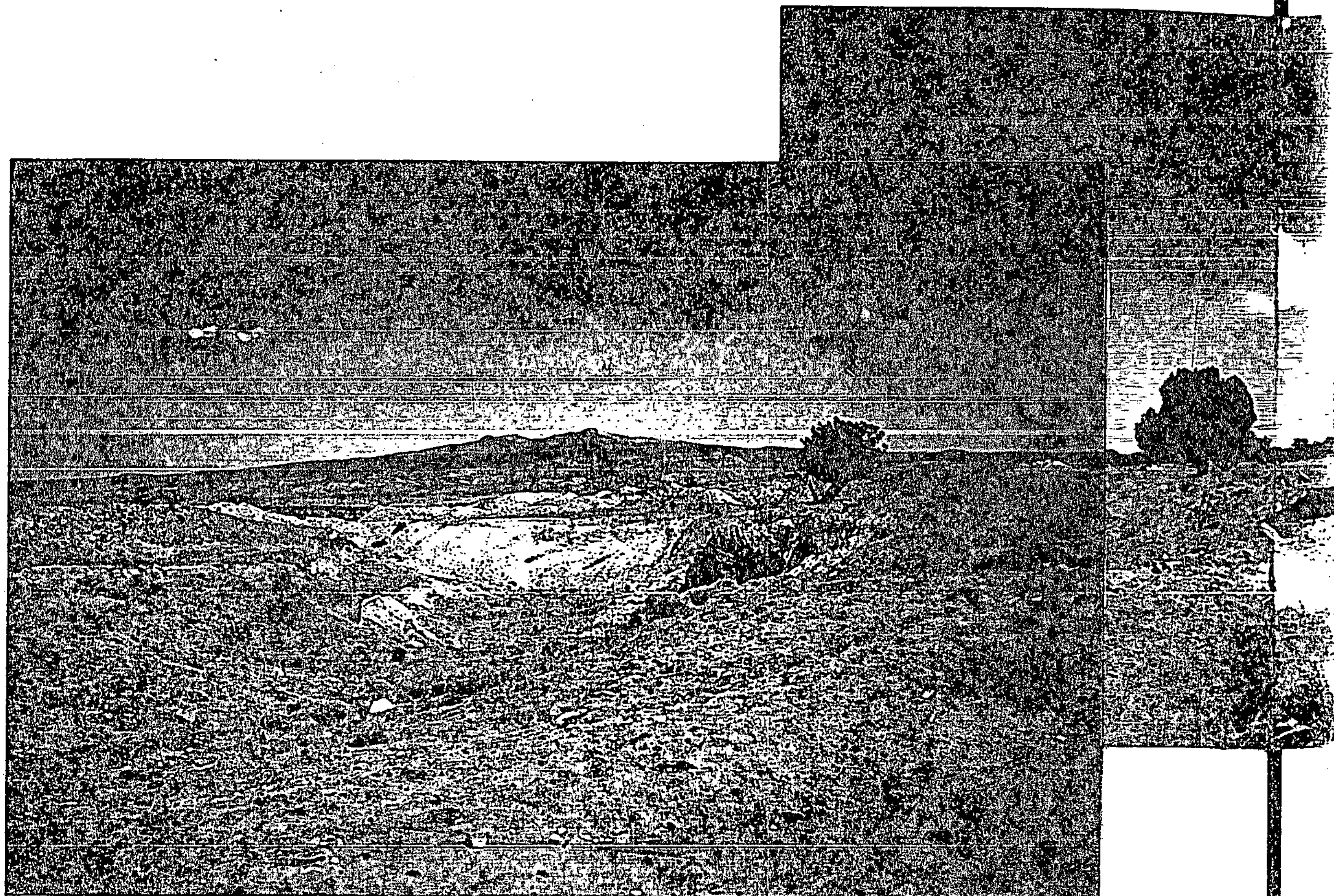
Photograph 2: The photo is looking northeast [illegible]. The sheep corrals near the mine waste [illegible]. The corrals are constantly used to hold livestock [illegible]. The middle ground shows most of the mine waste piles as seen from the Desiderio residences. The background consists of [illegible]

NAVAJO SUPERFUND OFFICE

DESIDERIO GROUP MINES

Photograph 2

S. EDISON JUNE '90



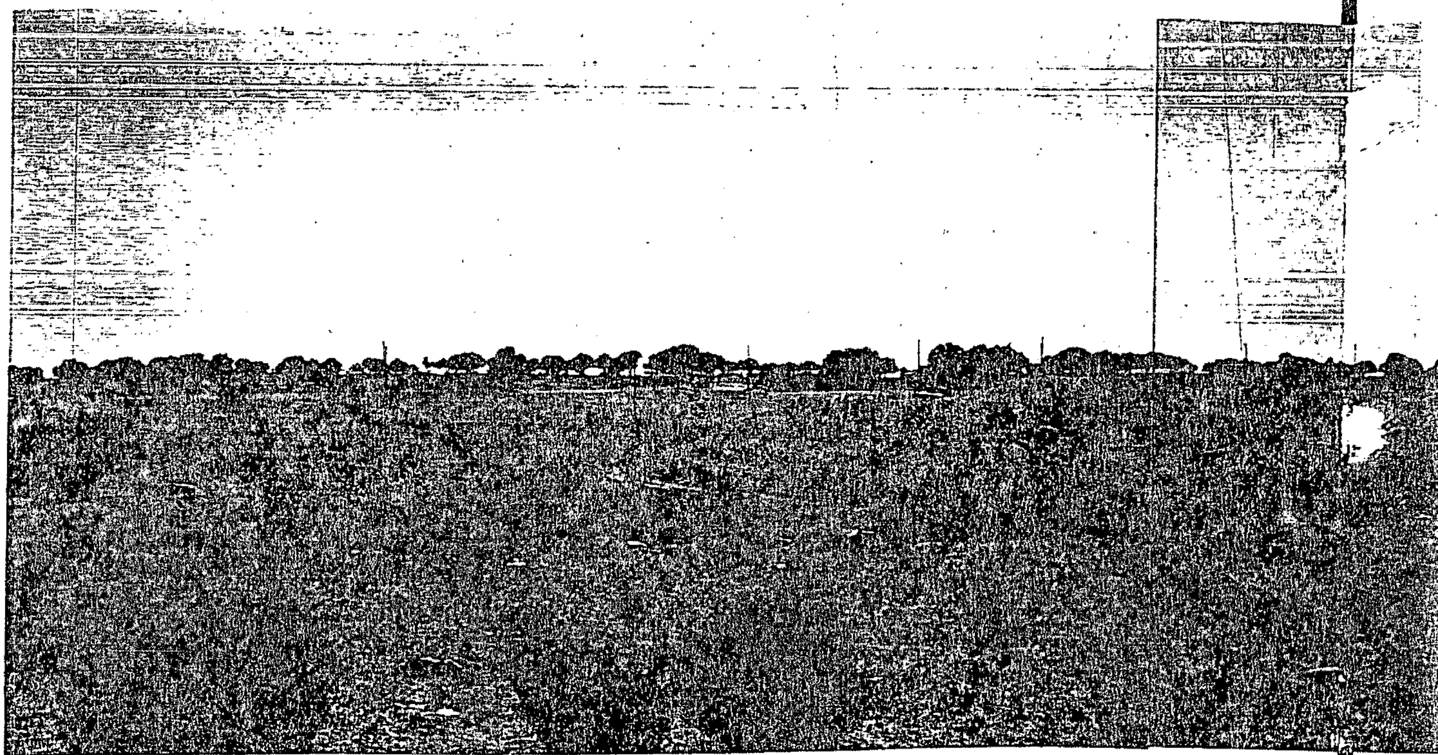
Photograph 3: The photo is looking east showing the relative distance from the resident to one of the open pit uranium mines. These open pit mines impound surface water which is utilized by livestock as a water source. On the horizon is Mt. Taylor located north of Grants, NM.

NAVAJO SUPERFUND OFFICE

DESIDERIO GROUP MINES

Photograph 3

S. EDISON **JUNE '90**



Photograph 4: The photo is looking west showing the open pit mines and the waste piles relative to the Desiderio residences.

NAVAJO SUPERFUND OFFICE

DESIDERIO GROUP MINES

Photograph 4

S. EDISON JUNE '90

Photograph 5: The photo is looking northwest showing rim cuts located less than a 1/4 of mile south of the Desiderio residence. The residence are located by the area light poles on the horizon. The background consists of Haystack Mountain and Mesa Montanosa.

NAVAJO SUPERFUND OFFICE

DESIDERIO GROUP MINES

Photograph 5

S. EDISON **JUNE '90**

Photograph 6: The photo is looking [illegible] showing the incline adit located 1/4 mile east of the Desiderio residence. The incline is driven down [illegible] bottom of a box cut. Note: There is evidence of surface water coming into the adit via the [illegible]. The adit is not fenced off and there [illegible] danger.

NAVAJO SUPERFUND OFFICE

DESIDERIO GROUP MINES

Photograph 6

S. EDISON **JUNE '90**

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105

NAVAJO-BROWN VANDERVER
AND
NAVAJO-DESIDERIO URANIUM MINING AREAS
NAVAJO NATIONS
BLUEWATER, NEW MEXICO
PRELIMINARY ASSESSMENT WORKPLAN

Prepared by Robert Bornstein
United States Environmental Protection Agency
Emergency Response Section
November 9, 1990

I. INTRODUCTION

On October 3, 1990, the Emergency Response Section (ERS) was notified by the Agency for Toxic Substances and Disease Registry (ATSDR) of the potential health hazards associated with the uranium mining tailing located at the Navajo-Brown Vanderver (N-BV) and Navajo-Desiderio (N-DO) Uranium Mining Areas. At this time, the ATSDR is drafting a Public Health Advisory for these areas based on the potential adverse environmental and health hazards associated with these mining sites.

II. BACKGROUND

The N-BV and N-D sites are located in Bluewater, New Mexico. The sites are located on land administered by the Navajo Nation and lie within the Ambrosia Lake subdistrict of the Grants Uranium Mining District. The N-BV mine encompasses approximately 155 acres, and the N-D mine covers about 130 acres. The Sites lie within a sparsely populated agricultural area. The Navajo Nation estimate that approximately 500 people may be affected by the environmental hazards associated with these sites.

The N-BV mine was operated periodically from 1952-1966 and was operated by several mining firms including Santa Fe Uranium, Federal Uranium Mesa Mining Company, and the Cibola Mining COmpany. The operations consisted of both surface and subsurface mining techniques. Several open shafts and large pits are visible at the site and access is not restricted. The mined ore was hand sorted and shipped to various milling operations located in Shiprock, New Mexico, or the Durango, Colorado, area. It is estimated by the Navajo Nation that approximately 25,000 tons were removed from the mine. The ore was processed into approximately 49 tons of uranium oxide (U_3O_8) and over 37 tons of vanadium pentoxide (V_2O_5). Mined ore which failed to contain sufficient quantities of uranium were discarded at the mine sites. These tailing piles remain exposed at the sites. Several tons of tailings are believed to have been used as base material for neighboring roads and concrete.

The N-D mine was believed to be operated from 1952-1957. The exact name of the operating company or companies is not known at this time. This mine primarily employed strip mining techniques. The Navajo Nation estimate that over 11,110 tons of uranium ore was extracted from this operation.

III. ASSOCIATED HAZARDS

The ATSDR initiated a preliminary investigation at the sites to determine if they pose physical, chemical and/or radiological hazards. In summary, the ATSDR determined that the open pits and shafts do pose a significant physical hazard to the neighboring populations. The open shafts and pits are not fenced or secured and neighboring children may accidentally fall or get lost within these pits or shafts.

The ATSDR noted that the heavy metals associated with the weathering mine tailings may pose a significant environmental and health hazard. Heavy metals such as chromium, arsenic, vanadium, and zirconium may be leaching from the tailing piles and may be adversely affecting the groundwater quality of the region. In addition, neighboring populations may be exposed to wind blown heavy metal particulates.

Finally, the tailing piles contain elevated concentrations of radioactive material associated with the decay and degradation of uranium. Radioactive particulates and radon gas are likely to be migrating from the tailings. ATSDR believes that the neighboring population may be exposed to unsafe levels of radiation.

IV. ATSDR RECOMMENDATIONS

ATSDR has recommended action to assess and assist the local residents. ATSDR has recommended that an educational program be implemented to inform the neighboring population of the potential health effects of the mines. In addition, ATSDR has recommended that a more complete and detailed assessment be performed to assess the health impacts associated with the tailings.

ATSDR recommended that additional data be collected to characterize the amount and extent of contamination associated with the tailings. This would include collecting and analyzing soil, air and surface and groundwater samples for heavy metals and radioactivity. To investigate the radiation exposure of the neighboring population, ATSDR recommended the implementation of a personal radiation dosimeter program. Personal radiation dosimeters would allow ATSDR to estimate the external radiation exposure levels of the community. In addition, a complete biota, food crop and livestock study should be undertaken to evaluate the internal radiation exposure levels of the neighboring communities.

To implement ATSDR's recommendations, several Federal agencies such as the Bureau of Indian Affairs, Indian Health Services, EPA Superfund Program, EPA Office of Air and Radiation, Department of Energy, State of New Mexico and others will need to be involved with this project.

V. EMERGENCY RESPONSE ROLE

The Environmental Protection Agency Region IX, Emergency Response Section (ERS) has been tasked to perform the geochemical and georadiological study of the sites to assess the environmental and physical hazards of the area. ERS, accompanied by its Technical Assistant Team contractor, Ecology and Environment, are prepared to collect and analyze tailing, soil, air, surface water, run-off sediment and groundwater samples. EPA's Office of Air and Radiation, Las Vegas, Nevada, will be supporting ERS with their expertise in conducting radiation surveys and overseeing personal radiation safety.

An initial gamma radiation survey will be conducted by Colleen Petullo, OAR, to determine the external radiation hazards associated with the site. An "Exclusion" zone will be delineated by Collen Petullo, OAR health physicist, to restrict non 40 hr trained personnel and unauthorized people from access to the study areas. In addition, areas with gamma radiation levels exceeding 2.5 millirem/hr will be classified as "Hot" zones and personnel will not be allowed to work in these zones without direct supervision and approval of the health physicist. All personnel will be monitored exiting the study area. Instruments and protective gear will be monitored for radiation. Every effort will be made to avoid the generation of radioactive waste. A formal decontamination protocol will be implemented.

Physical hazards such as open shafts and pits will be delineated and flagged. An inventory to estimate the volume of potentially contaminated material will be collected.

Both surface and boring samples will be collected within the tailing piles and surrounding areas. Storm channel deposits will be collected to determine if rain run-off is acting as a mode of contamination transport. In addition, neighboring water well samples and, if possible, surface water samples will be collected and analyzed. All samples will be analyzed for heavy metals, radioactive isotopes and radioactivity. The samples will be collected pursuant to an approved sampling and work plan being drafted by Ecology and Environment. An extensive photographic record will be made during the assessment.

Areas of elevated gamma radiation will be delineated and used as potential monitoring stations for calculating radon flux measurements. These measurements will determine the amount of radon being emitted into the atmosphere from the tailings. If warranted a complete radon gas monitoring program above and down-wind of the tailing piles will be developed and implemented. Several carbon absorption test kits will be employed to capture the radioactive gas. Testing will be pursuant to the radon flux method outlined in 40 CFR Part 61. A domestic radon monitoring program and a biota/livestock sampling program has been recommended by ATSDR and ERS will try to coordinate these activities will other Federal and Navajo agencies.

The assessment will be directed by the ERS On-Scene-Coordinator (OSC). The OSC will be consulting and working closely with the various other Federal and Tribal agencies participating in this investigation. The assessment is scheduled to begin on November 13, 1990. A meeting between ERS personnel and the Navajo Superfund program is scheduled on November 13, 1990 at 4:00 pm. The OSCs assigned to lead the assessment are Robert Bornstein (415-744-2298) and Robert Mandel (415-744-2290). The project Health Physist from OAR will be Colleen Petullo (702-798-2446). The TAT Project Leaders are Mary Sue Philips and Beverly Pester (415-777-2811).

Analytical samples will be sent to TMA/Eberline laboratory located in Albuquerque. Sample analysis will be determined by using a flow chart developed by OAR.

The results of the sampling program will be compared to both Federal and State Action levels governing radioactivity and heavy metals. The following radioactive standards will be employed:

- o Drinking Water: 40 CFR 141
  - MCL for radium-226 and radium 228: 5 pCi/l
  - MCL for gross alpha particule activity (including radium-226 but excluding radon and uranium): 15 pCi/l
  - MCL for gross beta: 50 pCi/l
  - MPC (10 CFR 20) 9E-4 uCi/ml (U^{234})
8E-4 uCi/ml (U^{235})
1E-3 uCi/ml (U^{238})
- o Soil: 40 CFR 192
  - Radium-226 in top 15 cm: not > 5 pCi/g over background
  - Radium-226 below 15 cm: not > 15 pCi/g over background
- o Ambient Air: 40 CFR 192
  - Radon-222: Average over 1 year over disposal areas not to exceed 20 pCi/m^2/sec (Radon Flux)
Annual average at residential areas not to exceed 0.5 pCi/m^2/sec (Radon Flux)
  - Radon-222 in occupied buildings: not to exceed .03 WL over background
  - MPC (10 CFR 20): 1E-10 uCi/ml (U^{234})
1E-10 uCi/ml (U^{235})
7E-11 uCi/ml (U^{238})
- o Gamma radiation survey standard: >= 100 millirem/year*

  * Proposed Standard by the Presidential Working Group on Radiation Safety (DOE,HHS,ATSDR)

MCL = Maximum Contaminant Level
MPC = Maximum Permissible Concentration

Based on the results of the assessment, ERS will determine if an immediate health risk exists. If the promulgated standards are exceeded and an immediate health risk is established, ERS will prepare an Action Memorandum pursuant to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300). If it is determined that a long term health risk is associated with the sites, ERS will refer this data to the Superfund Remedial Program. An emergency response action may include but is not limited to the following activities:

- o The physical removal or encapsulation of the tailing piles;
- o The proper closure of the mine pits and shafts;
- o The relocation of exposed population;
- o The supply of alternate water to the community;
- o The erecting of warning signs and a fence to restrict assess to the sites;
- o The application of a soil sealant to restrict the migration of contaminants from the sites.

If the NCP criteria for Removal Actions are met, an Action Memorandum will be forwarded to EPA Headquarters, Emergency Response Division to request funding approval. Headquarters approval is required because Removal Actions on Reservations have been determined to have "national" significance.

PROJECT CONTACTS

Robert Bornstein	On-Scene-Coordinator	415-744-2298
Robert Mandel	On-Scene-Coordinator	415-744-2290
William J. Weis	Enforcement Officer	415-744-2297
Linda Wandres	ORC	415-744-1359
Mike Bandrowski	Reg. Radiation Office	415-556-5285
Greg Dempsey	Las Vegas, OAR	702-798-2476
Colleen Petullo	OAR,Health Physicist	702-798-2446
Barbara Gross	Industrial Hygienist	415-744-1607
Louise Lincoln	Navajo Superfund	602-871-6422
Gavrav Rajen	Navajo Superfund	602-871-6859
Bill Nelson	ATSDR	415-744-2194
Mary Sue Philips	TAT Project Leader	415-777-2811
Beverly Pester	TAT QA Leader	415-777-2811
Vickey Radvila	TAT Member	415-777-2811

TRIP SCHEDULE

DEPARTURE: November 13, 1990 OAKLAND TO ALBUERQUE	--- America West Flight HP431/HP202 Departs: 0700 hrs Arrives: 1140 hrs via Pheonix
RETURN: November 16, 1990 ALBUERQUE TO OAKLAND	-- America West Flight HP640/HP10 Departs: 1705 hrs Arrives: 2015 hrs via Pheonix

Hotel: El Rancho, Gallup, New Mexico -- 505-863-9311
Car: Heritz Car Rental - 4 wheel drive - #7611-079-A4A6

ecology and environment, inc.
160 SPEAR STREET, SAN FRANCISCO, CALIFORNIA 94105, TEL. 415/777-2811
International Specialists in the Environment

12 April 1991

U.S. Environmental Protection Agency
Emergency Response Section
75 Hawthorne Street
San Francisco, California 94105

TAT: 099104-T-002
TDD: T099010-035
PAN: E09Z019-SAA

ATTN: William E. Lewis, DPO

SUBJECT: **Navajo Desiderio Group Uranium Mines Site Assessment**

On Thursday, October 4, 1990, the U.S. Environmental Protection Agency (EPA) Deputy Project Officer (DPO) William Lewis requested TAT members Mary Sue Philp and Beverly Pester to assist the EPA in conducting site assessments at two abandoned uranium mining areas on Navajo Indian Reservation land in New Mexico (Figure 1). On-Scene Coordinator (OSC) Robert Bornstein specifically charged TAT to develop a work plan and sampling plan to assess suspected radioactive and heavy metal uranium mining wastes. This was accomplished by an X-ray fluorescence (XRF) survey and acquisition of soil, water and radon flux samples. On-site gamma and beta radiation surveys were conducted by EPA. The data from these measurements will not be included in this report. The EPA Office of Radiation will summarize and report the findings of the radiological analyses performed on the samples taken.

1.0 Site History

The site consists of two mining areas, each owned by citizens of the Navajo Nation and populated by their extended family groups. Each family raises livestock on the land. The first site, known as the Navajo Brown Vandever mine (N-BV), covers approximately 155 acres (Figure 2). The second site is named the Navajo Desiderio mine (N-D) and encompasses 130 acres (Figure 3). Both the N-BV and N-D mines were open pit uranium mines and have been out of operation since the 1960's. No milling of the uranium ore was performed at either site; thus the contaminants present are solely a result of overburden. The overburden rock was not uranium-rich enough for processing and was, therefore, left on-site.

The sites have been under investigation by the Navajo Superfund Office (NSO) located in Window Rock, Arizona. Hazard Ranking System (HRS) packages have been prepared for each of them. The HRS ranks a site's potential for inclusion on the Federal Superfund National Priorities List (NPL). In addition, the Agency for Toxic Substances and Disease Registry (ATSDR) made a site visit during July and November 1990. A Public Health Advisory was released as a result of the site visit on November 21, 1990 (Appendix A). The ATSDR prompted the Region IX Emergency Response Section (ERS) of the EPA to investigate the severity of the situation.

2.0 Planning Activities

Prior to site activities, TAT developed a work plan (Appendix B), a site safety plan, and a rough model for the XRF. TAT coordinated the work with EPA Office of Radiation personnel as well as with the NSO.

2.1 Development of the XRF Model

Before the site visit, TAT developed a quasi-site-specific model to measure vanadium, chromium, and arsenic. Chromium and arsenic were chosen based upon reports they could be associated with uranium deposits and upon their toxicity; in addition, TAT already possessed the capability to model for those elements. Vanadium was an element of interest because it was expected to be present in high levels, since it is associated with uranium deposits of northern New Mexico.

In order to calibrate the XRF, the soil matrix of New Mexico was simulated by using a mixture of locally obtained sand and silt. The samples were then spiked with varying levels of vanadium (as vanadium (V) oxide), chromium (as chromium (III) oxide) and arsenic (as arsenic (III) oxide).

3.0 Site Activities

TAT arrived at the N-BV site the morning of November 14, 1990. Also present on-site were EPA Office of Radiation personnel, NSO personnel, and EPA ERS personnel. After obtaining background gamma radiation measurements on the access road leading to the N-BV property, the team proceeded to the N-BV residences to set up the support area. TAT conducted soil and water sampling, photodocumented site activities (Appendix D), operated the XRF, and provided technical assistance to the EPA health physicist on-site. NSO personnel were responsible for mapping the site. The maps constructed by OSC Bornstein from the notes taken by the NSO are included following this report (Figure 4 is a map of N-BV; Figures 4A through 4D are maps of N-BV sections 1 - 4; Figure 5 is N-D).

During the first day of field investigations, the XRF was used extensively on the N-BV site. The instrument, however, consistently read zero for each analyte of interest (vanadium, chromium and arsenic). In retrospect, this is primarily due to the fact that concentrations of chromium and arsenic were much less than the detection limit of the instrument (approximately 250 ppm). In the case of vanadium, concentrations were high enough that it could have been detected, since it existed on-site in concentrations up to 1,400 ppm. However, the inefficiency of the curium source probe for a low atomic weight element such as vanadium prevented its detection. Consequently, any further work at the N-BV or N-D site should utilize the light element probe, which employs an Fe-55 source; it has a much higher excitation efficiency for vanadium.

The team proceeded to the N-D site on November 15. A gamma survey and station mapping were conducted. Based on its ineffectiveness the previous day, the XRF was not used at the N-D site. A location was chosen for radon flux sampling (described below) and the sampling canisters were put in place.

3.1 Sampling

During the gamma radiation survey, the sites were divided into sections so that the survey could be conducted in an orderly fashion. During the survey, stations were designated based on geographical features and anomalies in gamma radiation levels, which were noted at each station (for station locations, see maps in Figures 4, 4A, 4B, 4C, 4D, and 5). Samples were taken in stations that showed elevated gamma radiation levels (typically 10 to 25 times background levels) or in areas that appeared to be drainage or runoff channels. A total of 21 soil samples (numbered 1A through 21A) were taken for metals analyses from both sites.

On November 16, TAT took seven water samples (numbered W1 through W7) from livestock wells and tap water at both the N-BV and the N-D sites. A surface water sample was also taken from the N-D stock pond.

4.0 Analytical Results

The seven water samples and 21 soil samples were submitted to TMA Eberline for metals analysis through their Monrovia, California facility. The samples were analyzed for the following metals: aluminum, arsenic, barium, chromium, lead, magnesium, manganese, molybdenum, selenium, strontium, titanium, and vanadium. This particular suite of metals was requested because they are often associated with uranium deposits. The results are summarized in Tables 1 and 2. The complete data package is available in the special projects file (TDD: T099011-102). The data validation memorandum follows this report (Appendix C).

4.1 Soil Samples

The soil samples were generally low in metals concentration, with the exception of aluminum (1,880 - 5,530 mg/kg), magnesium (612 - 2,770 mg/kg), manganese (105 - 2,580 mg/kg), strontium (21 - 227 mg/kg), and vanadium (6 - 1,410 mg/kg).

For aluminum, the designated level to protect ground water is 5,000 mg/kg in soil. Only Sample 10A exceeded this level; it was taken near the access road leading to the N-D site and was intended to be a background sample. This indicates that background levels of aluminum near the site are high and are not a result of uranium mining in the area.

There were no relevant standards or guidelines found for the maximum concentration of magnesium in soil. Despite its high concentrations, magnesium is not considered to be a problem at either the N-D or the N-BV site.

The designated level to protect ground water for manganese is 500 mg/kg in soil. Background sample 10A exceeded this level; all other samples were less than 250 mg/kg. Manganese is not considered to be a problem at either site.

The designated level to protect groundwater for strontium is 8,400 mg/kg. None of the samples exceeded this recommended limit.

The only regulation discovered concerning vanadium is the California Total Threshold Limit Concentration (TTLC), which can only apply as a guideline in New Mexico. The TTLC for vanadium is 2,400 mg/kg. The highest concentrations of vanadium in this suite of samples do not exceed the TTLC.

The only sample that consistently exceeded limits for metals concentrations in soil was Sample 10A, the background sample. This result suggests that natural soils in the area are high in aluminum, magnesium, and manganese. This may be due to vehicle use on the access road near the background sampling point.

4.2 Water Samples

None of the drinking water samples had metal concentrations in excess of drinking water Maximum Contaminant Levels(MCLs) or Suggested No Adverse Response Levels (SNARLs).

The sample taken from the livestock well (W1) contained 11.2 mg/L strontium, which exceeds the SNARL of 8.4 mg/L. The sample taken from the N-D stock pond (W6) had 4.8 mg/L barium, which exceeds the SNARL of 4.7 mg/L.

5.0 Radon Flux Sampling and Results

Radon (Rn-222) is an inert radioactive gas that is present in the decay chain of uranium. The danger in breathing radon gas does not lie in the inhalation of radon itself because most of the inhaled radon is exhaled. The few radioactive disintegrations that occur during inhalation yield tissue-damaging alpha particles as well as particulate radioactive daughter products which in turn undergo radioactive decay and damage lung tissue. Radon daughters are also inhaled with radon because the radon exists in equilibrium with its decay products. Radon has been linked with an increased incidence of lung cancer and was a contaminant of concern on both sites.

Regulations pertaining to outdoor radon emissions refer either to active mines or to the design of engineered remedial controls. Emissions from active mines are governed by 40 CFR 61.22, which states that emissions of Rn-222 are not to exceed that which would expose any member of the public to receive an effective dose of 10 mrem/year. The standard applying to remedial actions, 40 CFR 192.02 (b), dictates that control measures be designed to keep the average radon flux for the entire site below 20 pCi/sq m-sec.

The Desiderio site was chosen for radon flux sampling because it reportedly had higher levels of radiation than the N-BV site. Three small bluffs were chosen (Stations 5, 6, and 7) because they were flat, relatively accessible, and of a size appropriate to the fifty canisters allotted for the sampling.

Sampling was accomplished using a method modified from one published in EPA Publication 520/5-85-029. The method TAT used involved placing 50 four-inch diameter charcoal canisters (rather than the ten-inch canisters prescribed by the published method) on the soil for a twenty-four hour period. The canisters were sent to a laboratory for analysis. Radon flux values were calculated by measuring the gross radioactivity trapped on the charcoal and relating this value to the known area of the canisters (Table 3).

The average radon flux for Stations 5, 6, and 7 was 51.4, 67.0, and 47.7 pCi/sq m - sec respectively. The average radon flux for the three areas combined was 55.4 pCi/sq m - sec. All of these values exceed the standard for control measures.

In order to translate the flux values obtained at the N-D site into human exposures, a variety of data is necessary that is currently unavailable. For example, the prevailing wind direction from the three piles would indicate if the emitted radon was blowing toward the homes on-site. In addition, the flux of radon gas can vary widely over a given area and throughout the year. The radon flux values obtained from this sampling event represent a relatively small sampling of a sizable site; therefore, they cannot be considered statistically significant.

6.0 Conclusion and Recommendations

The concentrations of metals present at both the Brown Vandever and the Desiderio sites are not high enough to warrant action if they are considered apart from the radioactive elements on-site. However, there does appear to be potential for metals to leach into surface water. This is of concern because the livestock living on-site usually drink surface water.

The human risk due to metal exposure is probably highest from ingestion of contaminated dust particles. Considering the relatively low levels of metals present on-site, this does not appear to be a primary consideration.

The radon flux results are above the promulgated standard of 20 pCi/sq m - sec. Prior to the implementation of radon control measures, more extensive sampling is necessary to establish an accurate profile of radon gas emissions on-site. Possible remediation techniques could involve soil gas venting, though this may be prohibitively expensive for sites as large as Brown Vandever and Desiderio.

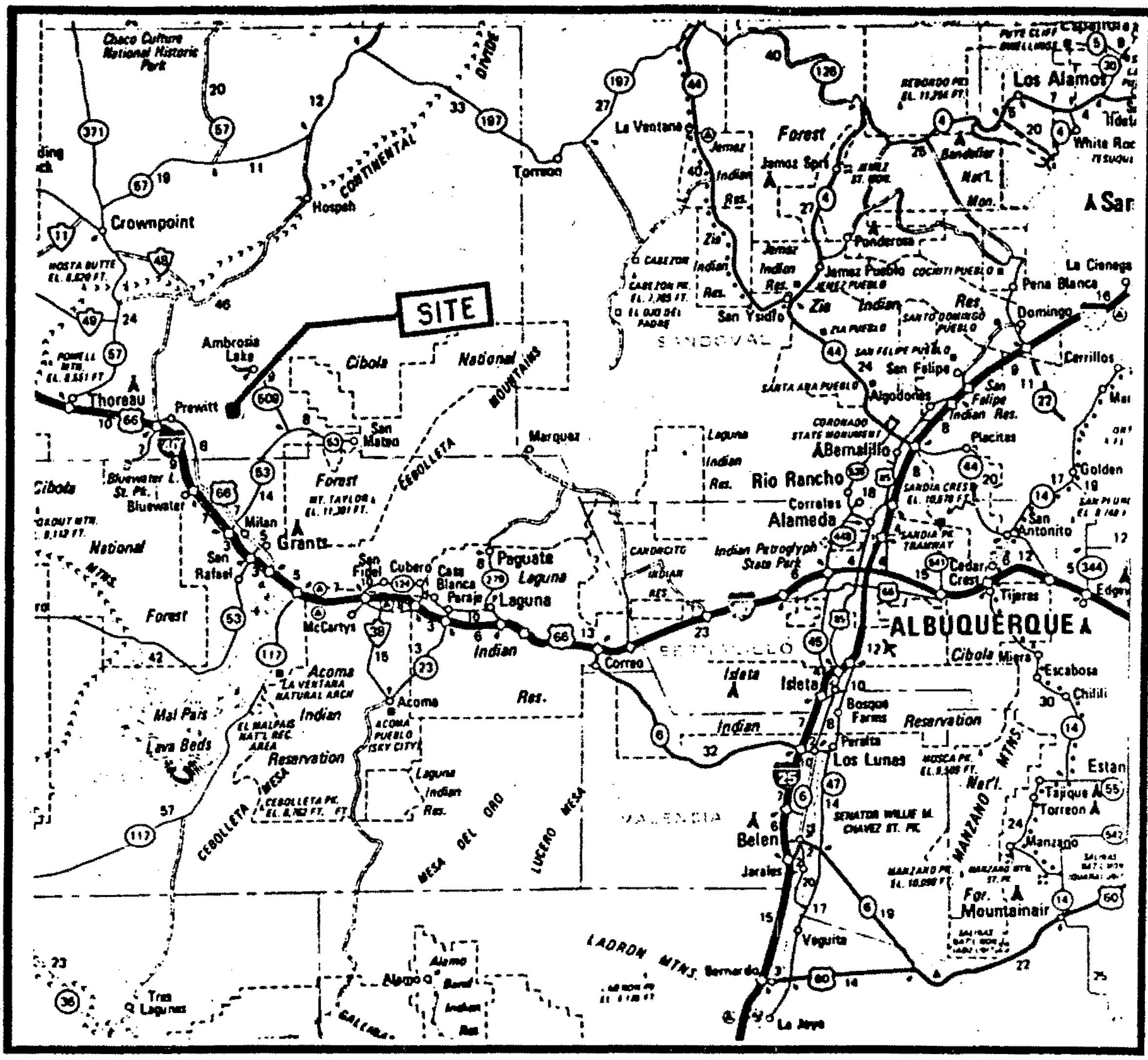
If you have any questions concerning this report, please do not hesitate to call this office.

Respectfully submitted,

Beverly Pester

Beverly Pester
Technical Assistance Team Member

cc: file
Robert Bornstein, OSC



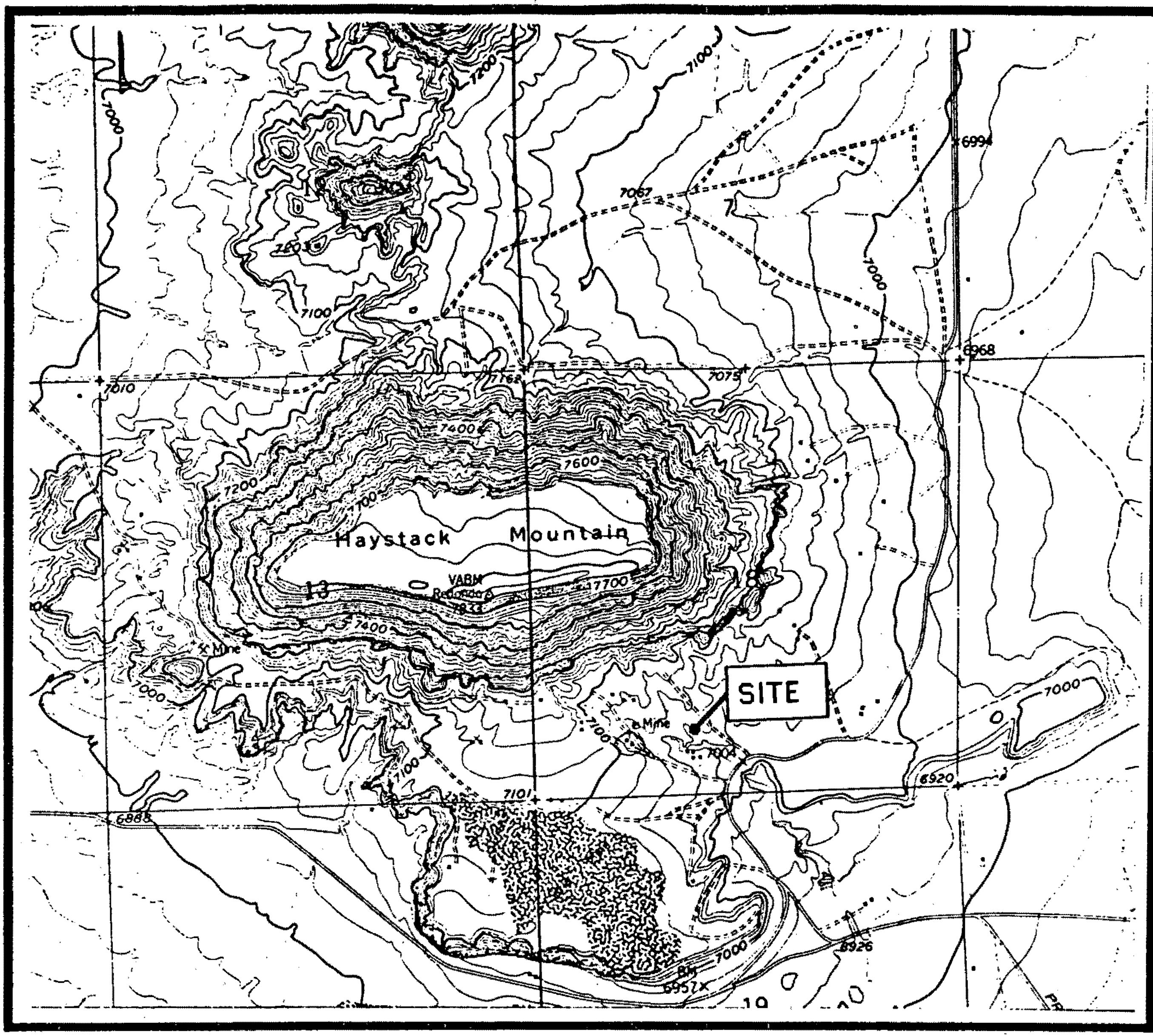
ecology & environment, inc.

scale 1 in = 20 mi

FIGURE 1
Site Location Map

N

Source: AAA Map
New Mexico
1985



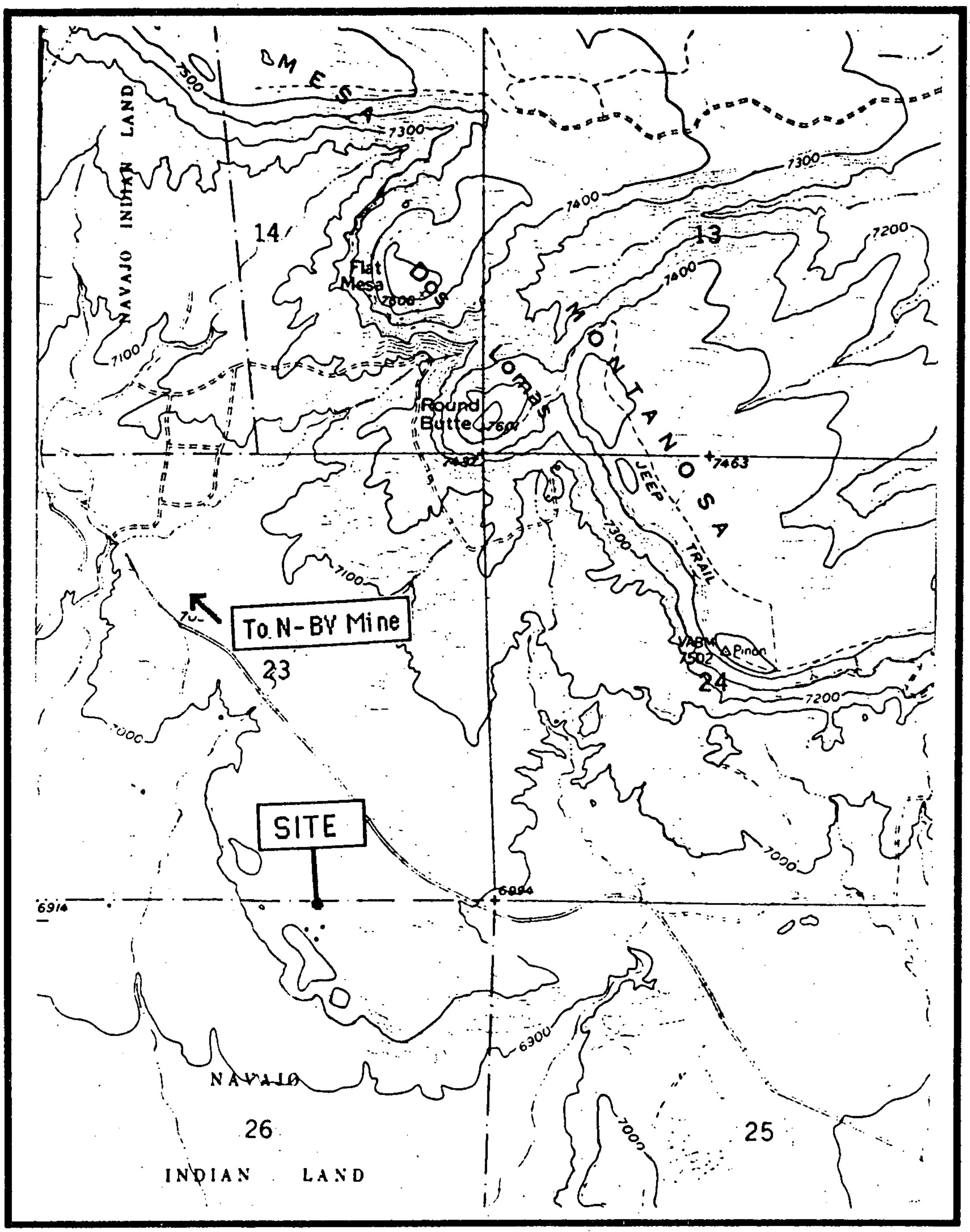
ecology & environment, inc.

scale 1 : 24000

FIGURE 2
Site Location Map
Navajo Brown Vandever Mine

N

Source: USGS map
Bluewater, NM Quadrangle
1980



ecology & environment, inc.

scale 1 : 24000

FIGURE 3
Site Location Map
Navajo Desiderio Mine

N

Source: USGS Map
Dos Lomas, NM Quadrangle
1980

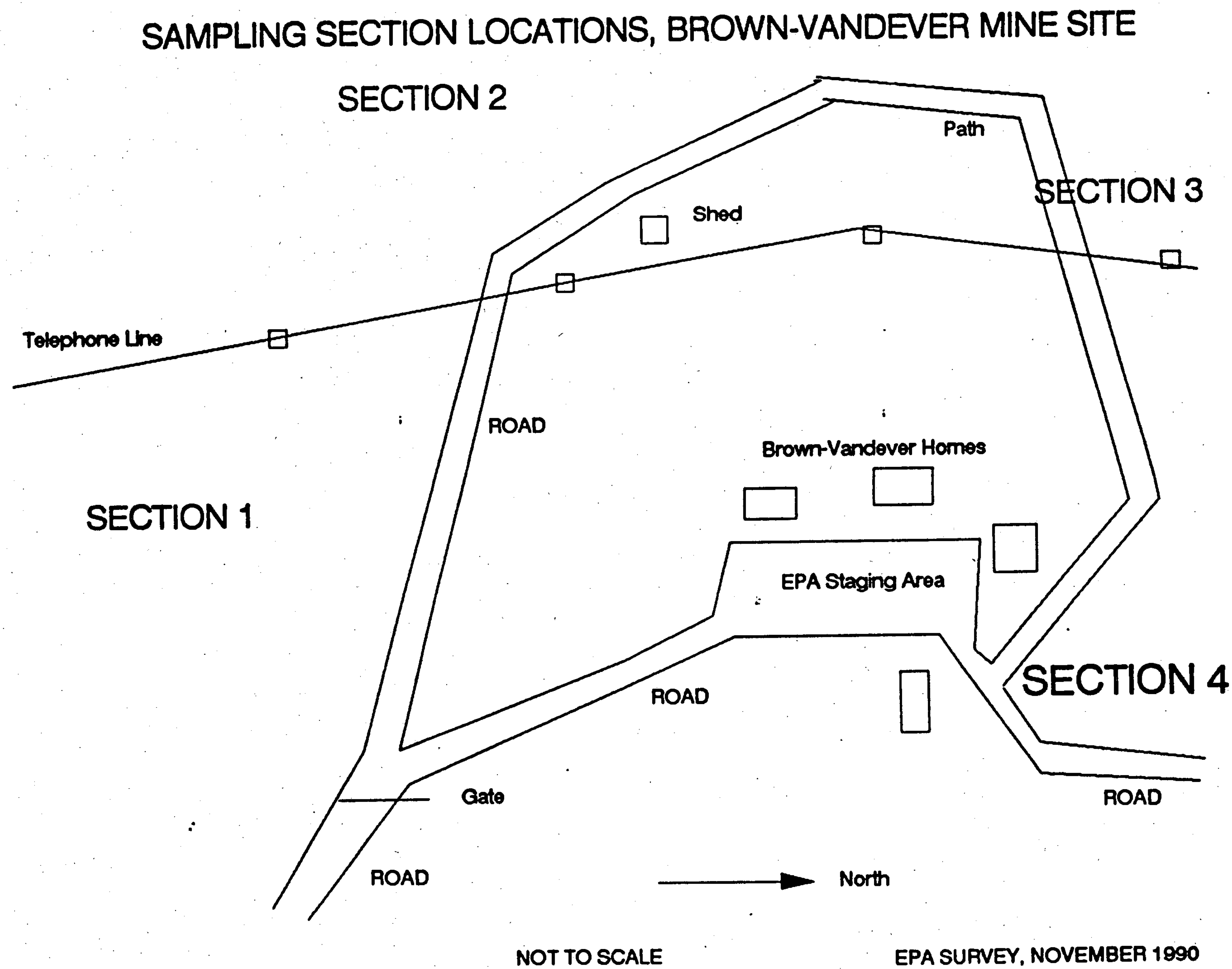


FIGURE 4
N-BV Section Location Map

SAMPLE LOCATIONS, BROWN-VANDEVER MINE SITE SECTION 1

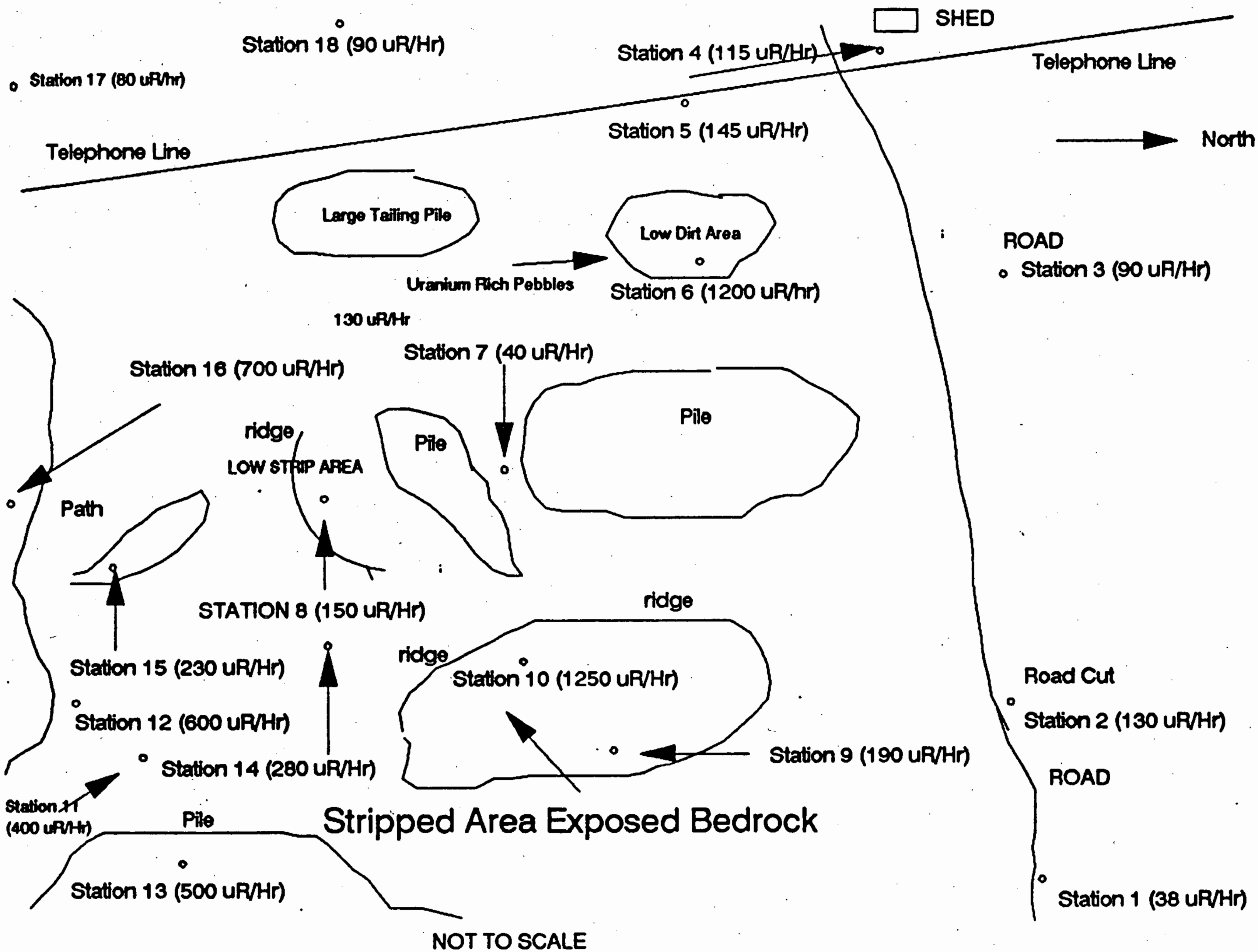


FIGURE 4A
N-BY Section 1

SAMPLE LOCATIONS, BROWN-VANDEVER MINE SITE SECTION 2

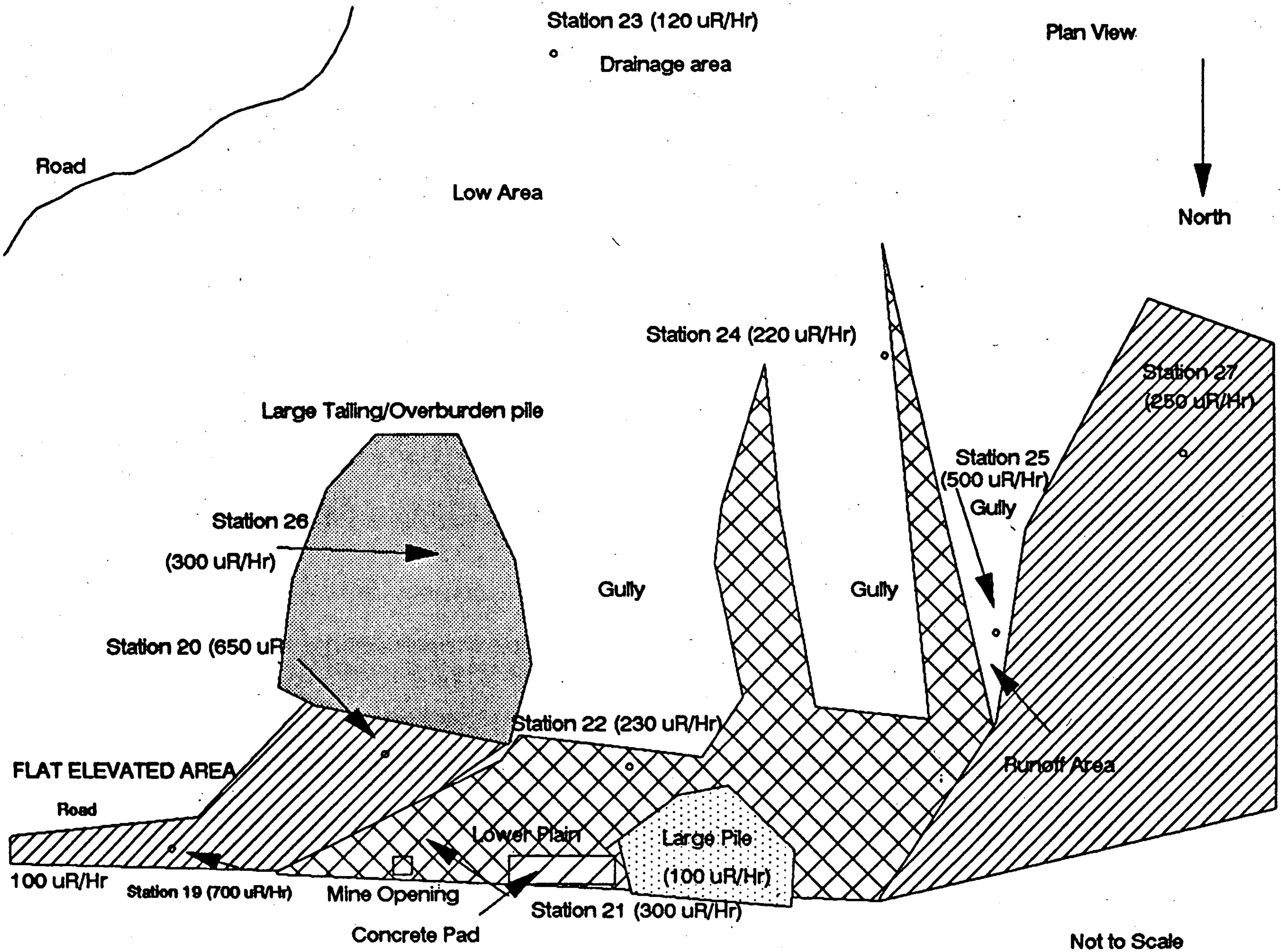
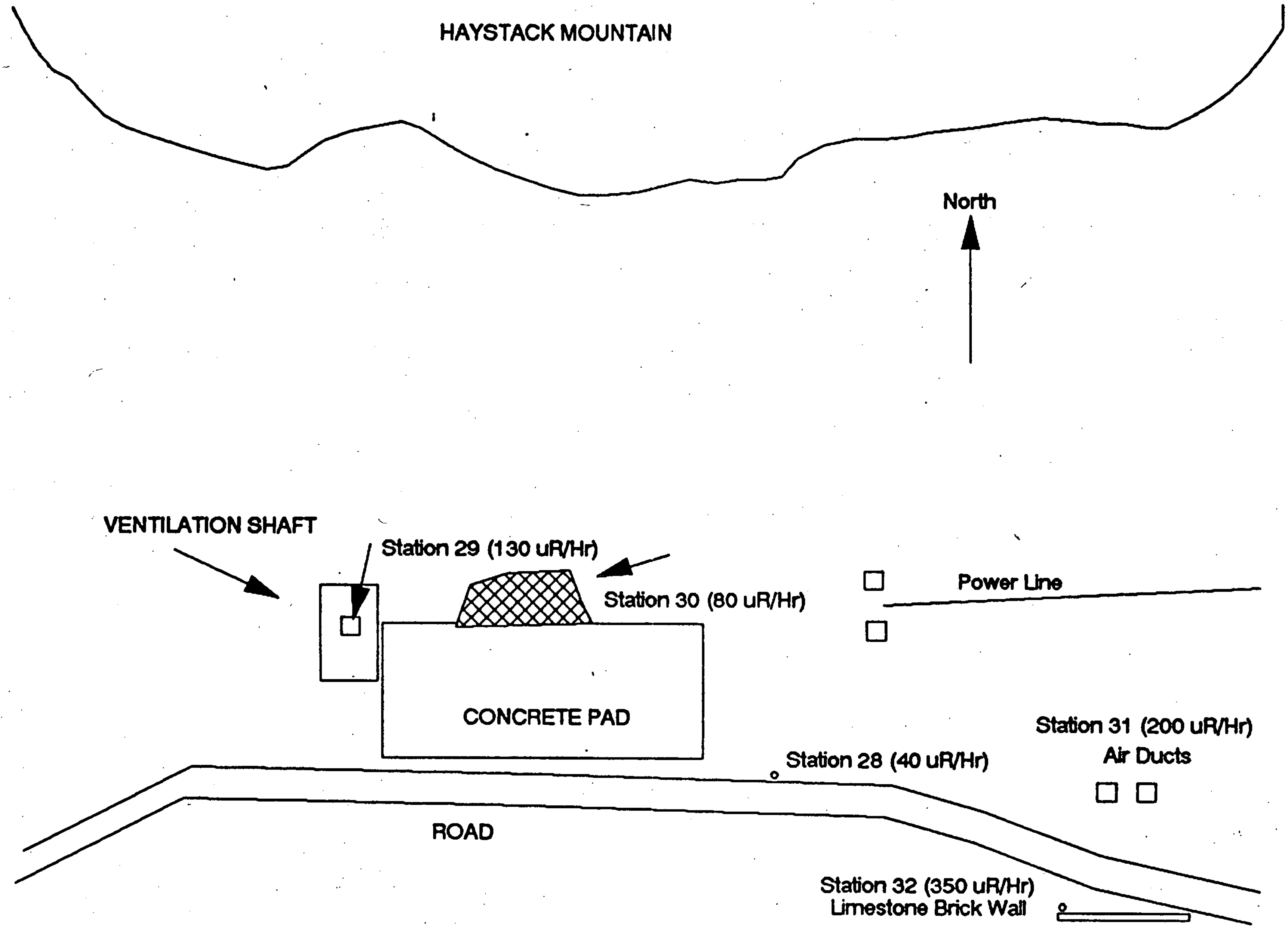


FIGURE 4B
N-BV Section 2

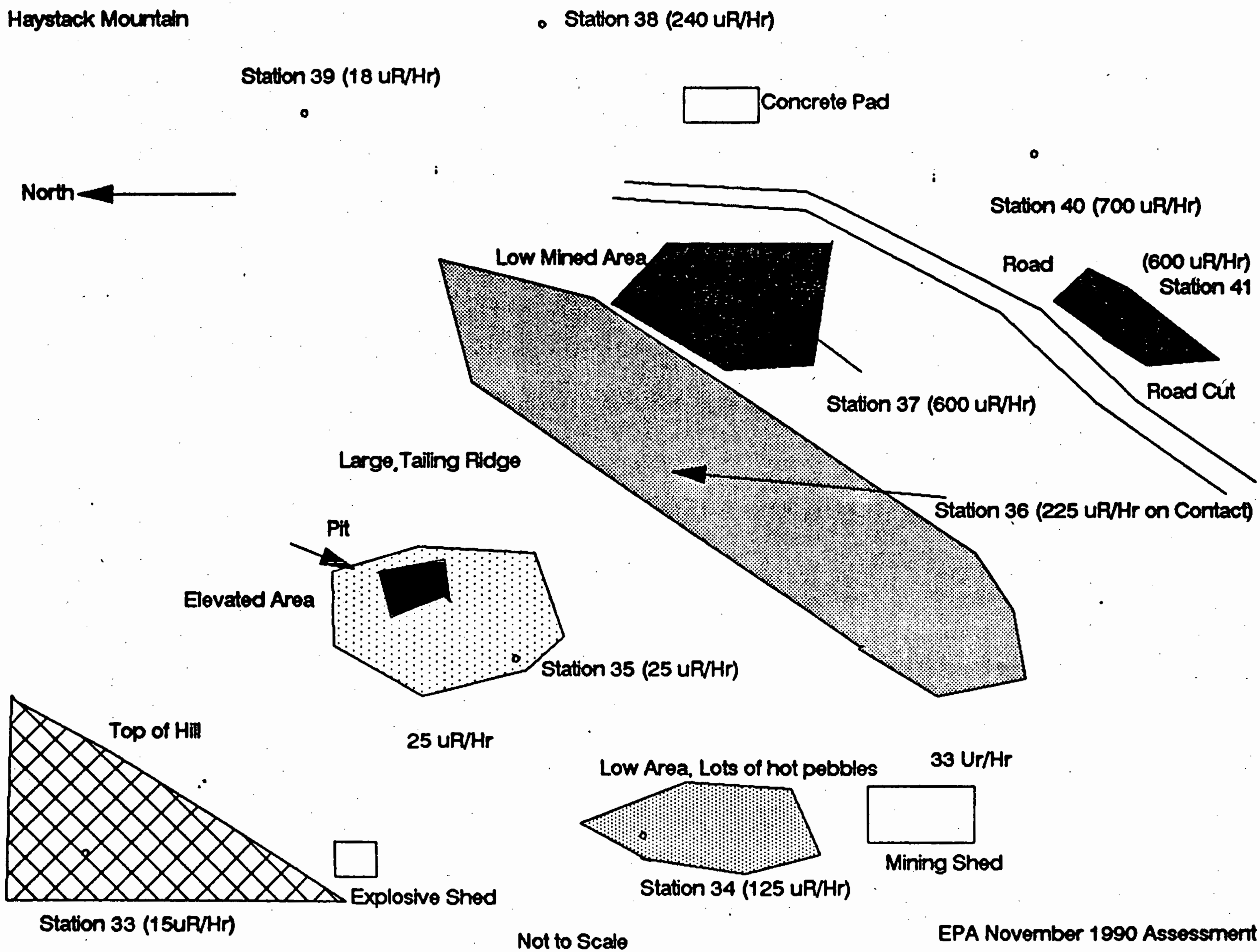
SAMPLING STATIONS, BROWN-VANDEVER MINE SITE SECTION 3



Not to Scale

FIGURE 4C
N-BY Section 3

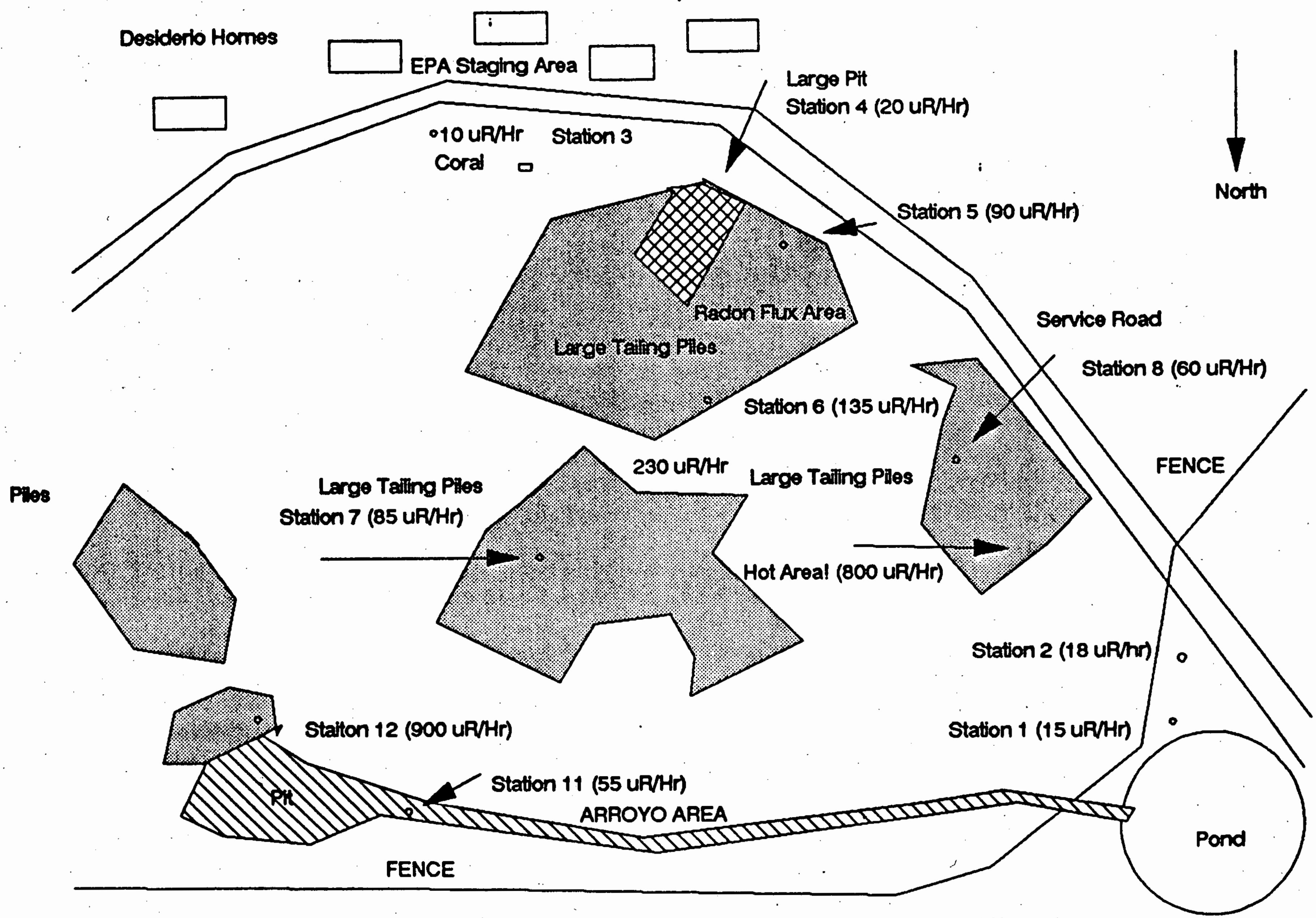
SAMPLING STATIONS, BROWN-VANDEVER MINE SITE SECTION 4



EPA November 1990 Assessment

FIGURE 4D
N-BY Section 4

SAMPLING STATIONS, DESIDERIO MINE SITE



Not to Scale

EPA Assessment November 1990
FIGURE 5
Navajo Desiderio Sampling Map

TABLE 1
Metal Analysis Results
Soil Samples

Analyte	Detection Limit	1A Area 20	2A Area 22	3A Area 23	4A Area 25	5A Area 6	6A Area 10	7A Area 11	8A Wash S. of Residences	9A Road Road to N-BV	10A Road to N-D
Aluminum	1,880*	4,107	2,120	<1,880(U)	<1,880(U)	4,210	3,640	4,320	2,970	3,060	5,530
Arsenic	0.7*	1.6	0.8	0.7	<0.7(U)	0.8	0.8	1.7	1.4	0.8	1.8
Barium	1	221	86.2	106	76.4	196	79	200	58.5	4,930	124
Chromium	360*	<360	<360	<360	<360	<360	<360	<360	<360	<360	<360
Lead	1.75*	17.9	4.1	4.1	<1.75(U)	9.2	8.3	26.6	21.9	3.9	5.9
Magnesium	22	2,770(J)	1,300(J)	993(J)	612(J)	1,800(J)	2,000(J)	2,580(J)	1,154(J)	1,480(J)	2,170(J)
Manganese	85*	260	146	151	142	226	229	273	105	2,580	181
Molybdenum	4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Selenium	0.2	0.9	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Strontium	5	150	162	103	24.3	182	154	15.3	25.5	35.1	22.6
Titanium	230*	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(u)
Vanadium	3	474	105	53.4	8.28	186	185	847	9.63	6.07	10.4

All values reported in mg/kg.
* These detection limits are revised to account for blank contamination.
(U) These analytes flagged as undetected due to revised detection limit.
(J) These values estimated due to poor initial calibration verification recovery.

TABLE 1 Contd.
Metal Analysis Results
Soil Samples

Analyte	Detection Limit	11A Mine Pit Near Corral	12A Radon Cartridge Areas	13A Radon Cartridge Areas	14A Station 11	15A Station 12	16A Station 9	17A Station 10	18A Station 30 Drainage	19A Station 36	20A Station 36 (dup)	21A Station 40
Aluminum	1,880*	3,970	4,000	3,720	4,000	4,370	3,920	3,450	3,450	2,120	1,880(U)	3,320
Arsenic	0.7*	<0.7(U)	5.2	10.2	1.4	1.5	1.0	1.5	1.2	0.7	0.8	6.0
Barium	1	91	132	104	69.7	58.4	62.3	20.5	90.8	205	201	65
Chromium	360*	<360	<360	<360	<360	<360	<360	<360	<360	<360	<360	<360
Lead	1.75*	2.4	9.5	7.0	3.3	3.1	2.9	2.4	3.0	1.9	2.7	23.1
Magnesium	22	2,160(J)	2,450(J)	2,440(J)	2,049(J)	2,130(J)	1,500(J)	1,830(J)	1,400(J)	1,310(J)	1,130(J)	1,930(J)
Manganese	85*	148	136	245	131	137	115	143	109	118	112	225
Molybdenum	4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Selenium	0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	1.4
Strontium	5	64	116	139	119	129	21.3	227	23	95	103	22.6
Titanium	230*	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)	<230(U)
Vanadium	3	5.67	11	12.7	11.2	9.43	6.85	10.8	7.59	89.9	95.3	1,410

All values reported in mg/kg.
* These detection limits are revised to account for blank contamination.
(U) These analytes flagged as undetected due to revised detection limit.
(J) These values estimated due to poor initial calibration verification recovery.

TABLE 2
Metal Analysis Results
Water Samples

Analyte	Detection Limit	W1 B-V Livestock Well	W1 Lab Duplicate	W2 Field Blank	W3 B-V Tap Water	W4 B-V Tap Water (Dup)	W5 Desiderio Stock Pond	W6 Desiderio Tap Water	W7 Preschool Well
Aluminum	0.03	<0.03	0.19	0.042	<0.03	<0.03	6.51	0.03	1.06
Arsenic	0.007*	<0.007(U)	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Barium	0.01	<0.01	<0.01	<0.01	0.03	0.03	4.79	0.03	<0.01
Chromium	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lead	0.0175*	<0.0175(U)	<0.0175(U)	<0.0175(U)	<0.0175	<0.0175	<0.0175(U)	<0.0175(U)	<0.0175(U)
Magnesium	5.5*	11.7(J)	11.2(J)	<5.5(U)	<5.5(U)	<5.5	5.5(U)	<5.5	<5.50(U)
Manganese	0.022*	0.103	0.1	<0.022	<0.022	<0.022	0.03	<0.022	<0.022(U)
Molybdenum	0.04	0.052	0.05	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Selenium	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Strontium	0.05	11.2	11.0	<0.05	0.12	2.55	0.26	0.12	0.12
Titanium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.22

All values are reported in mg/L.
* These detection limits have been adjusted to account for blank contamination.
(U) These analytes flagged as undetected due to adjusted detection limit.
(J) Flagged as estimated due to poor initial calibration verification recovery.

TABLE 3

Radon Flux Results

Station 5

Canister No.	Flux (pCi/sq m - sec)
1	52.9
2	62.3
3	34.9
4	36.1
5	38.7
6	48.1
7	39.8
8	35.7
9	68.5
10	69.7
11	64.3
12	39.5
13	129
14	121
15	24.9
16	68.3
17	21.0
18	26.3
19	19.1
20	27.7

Average Flux = 51.4 pCi/sq m - second

Table 3

Radon Flux Results

Station 6

Canister No.	Flux (pCi/sq m - sec)
21	17.9
22	65.2
23	87.7
24	58.1
25	45.0
26	41.8
27	81.5
28	60.5
29	44.6
30	45.2
31	55.6
32	55.7
33	143
34	121
35	81.8

Average flux = 67.0 pCi/sq m - second

Table 3

Radon Flux Results

Station 7

Canister No.	Flux (pCi/sq m - sec)
36	39.7
37	66.7
38	53.2
39	28.6
40	36.7
41	37.3
42	42.2
43	55.1
44	39.2
45	41.0
46	46.3
47	85.9

Average flux = 47.7 pCi/sq m - second

The three remaining samples were field blanks, all of which the laboratory found to have a flux of zero.

APPENDIX A

ATSDR Public Health Advisory

NOV 2 1 1990

The Honorable William K. Reilly
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Mr. Reilly:

With this letter, we are enclosing the Public Health Advisory for radiation exposure, potential exposure to heavy metals, and physical hazards associated with the Navajo-Brown Vandever and Navajo-Desiderio Uranium Mining Areas near Bluewater, New Mexico.

The Agency for Toxic Substances and Disease Registry (ATSDR) has evaluated the available environmental information for the inoperative Navajo-Brown Vandever and Navajo-Desiderio Uranium Mining Areas. As a result of this evaluation, we consider the sites a potentially serious threat to human health because of the presence of uranium mine wastes, associated radon emission, and the potential presence of heavy metals in residential areas. These areas also contain many readily accessible mine shafts and open-pit mining areas. In accordance with Section 104(i)(6)(H) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), ATSDR is recommending that you evaluate the sites for inclusion on the National Priorities List.

In the Public Health Advisory, ATSDR recommends the following actions:

1. The Environmental Protection Agency (EPA) should initiate data collection to characterize the contamination and its extent.

2. If the data being collected indicate that residents face an imminent radiation health hazard, immediate action should be taken to mitigate the hazard. If appropriate, this action could include the temporary relocation of affected residents until the hazard has been removed or mitigated.

3. Public water supplies and private wells in the area should be sampled immediately for radioactive materials and heavy metals.

The enclosed Public Health Advisory expresses our concerns and addresses measures to eliminate human health hazards. The Assistant Administrator of ATSDR, Dr. Barry L. Johnson, has notified the EPA Region IX Administrator, the New Mexico State Department of Health, and the Indian Health Service about this Advisory.

Sincerely,

William L. Roper, M.D., M.P.H.
Administrator

Enclosure

cc:
EPA Administrator, Region IX
New Mexico State Department of Health
Indian Health Service
Indian Health Service, Navahoe Area Office
PHS Region VI
ATSDR Region VI
ATSDR Region IX

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY
PUBLIC HEALTH ADVISORY

NAVAJO-BROWN VANDEVER
AND
NAVAJO-DESIDERIO URANIUM MINING AREAS
NAVAJO NATION
BLUEWATER, NEW MEXICO

November 21, 1990

Statement of Purpose

This Public Health Advisory is issued to inform the Environmental Protection Agency (EPA), the Navajo Nation, the Indian Health Service (IHS), the Bureau of Indian Affairs (BIA), the State of New Mexico, and the public of a potential significant environmental hazard to human health near Bluewater, New Mexico. After evaluating available information (1,2) and visiting the area, the Agency for Toxic Substances and Disease Registry (ATSDR) has determined that this Public Health Advisory is warranted for the Navajo-Brown Vandever (N-BV) and Navajo-Desiderio (N-D) Uranium Mining Areas. The presence of uranium-containing radioactive mine wastes, areas potentially contaminated with heavy metals, and many physical hazards form the basis of this Advisory. Because of these potential hazards to human health, the ATSDR is recommending that these sites be evaluated for inclusion on the National Priorities List.

At the request of the EPA, Region VI, and the Navajo Superfund Office (NSO), the ATSDR initiated preliminary investigations of the radiological, chemical, and physical hazards associated with the N-BV and N-D uranium mines. These sites are not currently on the National Priorities List, but the NSO and the EPA are currently developing Preliminary Site Assessments.

Two site visits by the ATSDR staff were made to the Navajo-Brown Vandever and Navajo-Desiderio Uranium Mining Areas. Field monitoring data were taken at the time of the visits. The ATSDR has concluded, based on the site visits, the data acquired during the visits, and the evaluation of other available information, that radioactive materials potentially hazardous to human health may be present at these sites. These hazardous materials include uranium-containing mine wastes with radiation levels potentially hazardous to human health, areas potentially contaminated with heavy metals at soil concentrations potentially hazardous to human health, and many physical hazards of public health concern. This finding has led to the issuance of this Public Health Advisory.

Background

The N-BV and N-D sites are in Bluewater, about 4 and 9 miles east of Prewitt, New Mexico, respectively (1,2). Both areas are in the Ambrosia Lake subdistrict of the Grants Uranium Mining District. Access to the areas is over improved dirt roads. These mining areas are in agricultural rural settings and adjacent to residential properties. Both mines are located on land owned by the Navajo Nation and held in trust by the Bureau of Indian Affairs, United States Department of Interior. The current owner of the N-BV mine is Mr. Brown Vandever, who lives at the site with his extended family. The owner of the N-D mine is Mrs. Jenny Desiderio, who inherited the mine from her deceased husband and lives on the site with her extended family.

The NSO estimates that at each site there are approximately 65 people, 30 of whom are children. Less than 3 miles from the sites is a preschool with a student enrollment of about 30 children. The NSO also estimates that about 500 persons are potentially impacted by environmental hazards at these sites.

A potable municipal-type water supply system for the area is derived from a well installed by the IHS. The NSO estimates depth of the well is about 1,100 feet. However, the NSO believes that not all residents are on this water system. The wells used by those residences not on the public supply are well systems operated by windmills.

The N-BV area encompasses about 155 acres (1), and the N-D mine covers about 130 acres (2). Within a mile of the N-BV mine is the Navajo-Nanabah Vandever (N-NV) mine site. These sites initially were open-pit mining operations. Besides the open-pit operations, the N-BV area operated as a subsurface mine. The site therefore includes horizontal mine shafts and ventilation shafts, some of which are almost vertical. During the site visits, the ATSDR observed that household wastes had been deposited into some of these shafts. It was apparent that local residents were still using these shafts for solid waste disposal.

Historically, the N-BV mine was operated periodically from 1952 to 1966 by various companies including Santa Fe Uranium, Federal Uranium Mesa Mining Company, and the Cibola Mining Company. During the operations of this mine, conventional mining techniques were used. The ore removed from the mine was believed to be sorted by hand and shipped to regional mills located near Ambrosia Lake or Shiprock, New Mexico, or the Durango, Colorado, areas. In its draft Preliminary Assessment of the site, the NSO documented that over 25,000 tons were removed from the mine. The ore processing produced about 49 tons of uranium oxide (U_3O_8) and over 37 tons of vanadium pentoxide (V_2O_5). Ores not meeting the screening criteria for uranium content were discarded at the mine site. These ores now line the roads leading to the Brown-Vandever residential and mine areas (1).

From 1952 to 1957, the N-D mine was operated by "Sante Fe" (exact name unknown, may not be the same company as previously mentioned) and the Hanosh Mines from Grants, New Mexico. The mining technique involved removing the soil overburden with heavy equipment followed by drilling and blasting the ores loose. The ores then were trucked to area mills for processing. Ores not meeting the minimum requirements for uranium content were disposed of at on-site locations. The NSO estimates that the 11,110 tons of ore removed by this operation contained over 83,000 pounds of U_3O_8 and over 17,500 pounds of V_2O_5 (2).

At both the N-BV and the N-D mines, the physical hazards are of particular concern to the ATSDR because of the number of children known to reside in the areas. The physical hazards observed by ATSDR include both open mine shafts and open pits. Because of the depth of the shafts and the unrestricted access, an inadvertent intruder either entering or falling into the shafts could be difficult to find and rescue.

Explanation of Terms

This document uses terms associated with radioactivity and dose resulting from radiation exposure. These terms are defined here.

curie -- A curie (abbreviated Ci) is the unit used to measure the amount of radioactivity. It is equal to the amount of radioactivity in 1 gram of radium (1 gram = 1/28 ounce or 0.0022046 lb). A picocurie (pCi) is one trillionth of a curie (1×10^{-12}). One trillionth is the same as 1 second in 320 centuries or 1 inch in 16 million miles. Exposure levels of the radioactive gas radon are commonly expressed as picocuries per liter of gas (pCi/L).

roentgen -- A roentgen (abbreviated R) is used to measure exposure to ionizing radiation, such as gamma rays or X-rays. Gamma radiation is energy given off by certain radioactive substances, such as uranium and radium. Basically, a roentgen defines the amount of energy given off by these radioactive substances into the air. An exposure of 1 R = 87.7 rads per 1 gram of air.

rad -- The abbreviation "rad" stands for radiation absorbed dose. It measures how much radiation is absorbed by a material after exposure to radiation. It is equal to 100 ergs of energy per gram of material (an erg measures energy).

rem -- The abbreviation "rem" stands for roentgen equivalent man. It is a function of the radiation absorbed dose (rad) and the type (or quality) of radiation. In terms of radiation quality, gamma rays are the least harmful internally to humans and alpha particles are the most harmful. The effect of 1 rem is approximately the same as that of 1 R of X-ray or gamma ray radiation. A millirem = 1/1-thousandth of a rem, the same as a dollar in $1,000. A microrem = 1/1-millionth of a rem, the same as 1 minute in 2 years or 1 inch in 16 miles. Throughout the United States, the average natural radiation exposure (called "background levels") is nearly 300 millirems per year. This includes exposure to radon.

Background radiation occurs from natural sources in the earth's crust. Several naturally occurring radioactive materials contribute to this source of radiation. These include, but are not limited to, uranium, thorium, rubidium, and a small percentage of potassium. Other sources contributing to the background include fallout from cosmic radiation, materials made radioactive as a result of interactions with the cosmic radiation, and nuclear weapons testing. A measurement of the background radiation was collected at Prewitt, New Mexico, approximately 3 miles from these sites by the ATSDR and the NSO. Using radiation detectors sensitive to gamma radiation, the background radiation at Prewitt was estimated to be 6 microroentgens per hour (uR/h). This is equivalent to an annual exposure of 53 millirem, not including radon.

<u>Basis for Advisory</u>

During the week of July 24-27, 1990, and November 1, 1990, personnel from ATSDR Headquarters and Regions VI and IX offices toured these sites. Accompanying the ATSDR personnel were representatives of the local Navajo chapter and the NSO. During the visits, radiation readings were collected by both the ATSDR and the NSO. Discussions also were held with officials and members of the Navajo Nation concerning life-styles, populations, health concerns, and land use in these areas.

A. Navajo-Brown Vandever (N-BV) Site

Along the roadbed leading to the Navajo-Brown Vandever site, the area was littered with rocks and ore tailings. Mine tailings from the nearby Nanabah Vandever mine were within 100 feet from the roadbed. These piles were partially overgrown with vegetation. Within the materials along the roadbed, the uranium ores (yellowish material) were clearly visible. Environmental radiation readings along the road, obtained with a calibrated Ludlum Model 19 gamma radiation detector equipped with an NaI(Tl) scintillator, ranged from approximately 50 microroentgens per hour (uR/h) to over 500 uR/h, whereas the naturally occurring background radiation reading was 6 uR/h. The background radiation measurements were obtained in Prewitt, New Mexico, approximately 3 miles from the sites. Radiation monitoring evidence also suggested that radioactive material had migrated off-site because of both wind-borne distribution and surface runoff during seasonal rains. Additional radiation monitoring indicated that some residential structures contained radioactive material in the foundations and that radioactive materials were also present within 20 feet of the residential areas.

At the main mine shaft located in the pit-mined area, ore tailings were randomly piled around the site and radiation readings were elevated above background. A horizontal shaft entering the mountain was observed; and during discussions with local residents, it was mentioned that the shaft branches into three sections. Entrance to this mine shaft is not restricted. Vertical ventilation shafts were also observed; one shaft was about 10 degrees from vertical. A small shack was constructed over this ventilation shaft, however, access to the shaft was not effectively restricted. Located near the residential areas were open adits (shafts) being used as solid waste disposal areas by the local residents. These adits may run at least 300 feet in length or depth. The residential areas are less than 200 feet from several adits, and access to these adits is also unrestricted.

Although air sampling data are lacking, because of the uranium content of these mines, the shafts provide an excellent path for the release of radon, a naturally occurring by-product of uranium decay. It is reasonable to infer that the release of radon from these mines could elevate ambient radon to levels potentially hazardous to human health at this site.

During mining operations, analysis of the ores indicated the presence of heavy metals. These included vanadium, arsenic, barium, chromium, magnesium, manganese, strontium, titanium, and zirconium. Leaching may have occurred from these ores; however, no analyses of environmental samples are available to verify the presence of these contaminants. Although recent sampling information is lacking, the potential exists for humans to be exposed to these contaminants through ingestion or inhalation.

B. Navajo-Desiderio (N-D) Site

The Navajo-Desiderio mine is a series of open-pit areas of approximately 30 to 50 feet in depth and of varying lengths. The radiation readings at this site were about 50 uR/h. No restricted access to the pits was observed during the site visit; children play and livestock graze freely in the area, and residential areas are within 100 yards of the pits.

Through a Navajo interpreter, the owner of the mine, Mrs. Jenny Desiderio, informed us that her grandson fell into one of the pits during a sledding accident. The child, who reportedly suffered brain damage, died a few years after the accident. According to Mrs. Desiderio, at least 18 livestock died after ingesting contaminated rainwater that reportedly collects in the pits. Whether the dead animals were examined by a veterinarian is not known. Although sampling data are lacking, the NSO officials believe the animals may have died after ingesting heavy metals which may have leached from the ores into the pit areas.

C. Discussion of Site-related Radiological Contaminants

Of the verified contaminants in these areas, those of concern are uranium and a member of its decay series, radon. Of the naturally occurring isotopes of uranium, uranium-238 (U-238) is the most abundant, present at concentrations greater than 99 percent. The primary mode of decay is via two alpha particles, each with a decay energy of approximately 4.2 million electron volts (MeV). The decay chain of which U-238 is the parent results in the production of both radium-226 and radon-222 and ultimately

...posure to Rn-222 is 2.1×10^{-3} per pCi/L exposure ... environmental conditions. The NCRP also states that the dose to the bronchial regions of a typical working adult because of exposure to Rn-222 is 0.27 rad per year per pCi/L. For a 10-year old child (12 hours active, 12 hours resting), the dose estimate is 0.45 rad/year per pCi/L.

D. Estimates of Radiation Exposure to Local Residents

Because detailed environmental monitoring for heavy metals and radioactive materials has not been supplied to the ATSDR, it is difficult to determine the health risks due to internal uptake of these materials. However, the external exposure to ionizing radiation can be evaluated using the on-scene monitoring results obtained by the ATSDR and the NSO. It is possible that the radiation exposures at these sites poses an imminent radiation health hazard to local residents. For the sites discussed in this Health Advisory, the ATSDR is defining an imminent radiation health hazard as exposures that exceed the regulations for radiation exposure to minors (as described in 10 CFR 20.104) and exposure to the public in areas of unrestricted access (10 CFR 20.105).

The Brown-Vandever mine site is in a residential area. In estimating the annual exposure to external ionizing radiation because of the contaminants in the area, the ATSDR used the following assumptions for a maximally exposed individual (MEI). The MEI would live on the site for 100 percent of the time (24 hours) and 365 days per year. The average exposure, including background in the area, is estimated conservatively to be approximately 125 uR/h. Assuming these values and the 24-hour exposure, the external radiation at this site could result in an individual receiving an external annual exposure of nearly 1 R, about 5 percent of which is from natural background as measured in the vicinity of the site (6 uR/h for 8,760 hours).

The risks of exposure to radiation have been investigated for nearly 100 years and the values have been extensively peer reviewed and accepted by the scientific community. In terms of risk estimates, the NCRP, in 1987, used a risk value for excess cancer mortality of 1×10^{-4} per rem per year for whole body exposure (7). In 1990, the NRC released the Biological Effects of Ionizing Radiation Report V, (BEIR V) (8). This report places the risk of excess cancer mortality as a result of continuous lifetime exposure to 0.1 rem per year at 520 for males and 600 for females per 100,000 population (Table 4-2, BEIR V report). Using the estimated population of 500 persons for this area, this would calculate to approximately three excess cancer deaths to residents as a result of exposure to the radiation over an estimated lifetime of 70 years. The American Cancer Society estimates that the expected rate of cancer deaths is on the order of 15 to 25 deaths for a population of 500 individuals.

Furthermore, because of the inherent production of radon released from the uranium-containing ores, the internal radiation dose, especially to the bronchial epithelium of the lungs, could be even higher. In a 1988 report, the NRC stated that the estimated dose to these tissues far exceeds any dose to organs from external natural background radiation (6). As an organ system, the allowable exposure limits for the lungs can exceed the whole body exposure dose limits (7). However, since no specific radon measurements have been made in this area, estimates of potential internal lung exposure to radon cannot be evaluated at this time.

Conclusions

The Agency for Toxic Substances and Disease Registry concludes that the Navajo-Brown Vandever and the Navajo-Desiderio Uranium Mining Areas may pose a potential significant hazard to human health for residents of these areas based on these premises:

1. The predictions of the external exposure model using the estimated exposures to ionizing radiation exceed the recommendations of the National Council on Radiation Protection and Measurements by a factor of 10. These recommendations state that the public exposure limit to continuous or frequent ionizing radiation should not exceed 0.1 rem per year (7), whereas, the estimated exposure to residents in the vicinity of the Brown Vandever mine could be on the order of 1 R (equivalent to 1 rem).

2. Possible human consumption of livestock potentially contaminated with heavy metals following the ingestion of standing water may pose a hazard to human health.

3. The many open mine areas, mine shafts, and the unrestricted access to these areas create a safety hazard.

4. Since evidence suggests that radioactive contaminants are migrating off-site and that heavy metals may be associated with the radioactive material, local food and livestock crops could be contaminated. This could result in a significant internal exposure to both radioactive materials and heavy metals if these crops are ingested.

5. It is apparent that not all local residents are supplied with public water. Because of the runoff and surface contamination around these sites, the water quality of the individual wells may be suspect and hazardous to humans chronically exposed to radioactive materials and heavy metals.

RECOMMENDATIONS

The ATSDR proposes the following health actions to assist local residents:

1. The ATSDR, in coordination with the Navajo Tribal Council, the IHS, the BIA, the State of New Mexico, and other appropriate agencies, will conduct an environmental health education program to advise the public and medical community of the nature and possible consequences of exposure to ionizing radiation and heavy metal contaminants at the N-BV and N-D sites. Health education materials and assistance will be provided to local health care providers and other appropriate local public health officials.

2. The ATSDR will consider conducting health surveillance activities for populations at these sites.

3. The ATSDR will consider conducting a radiation or heavy metal exposure study of the local residents once additional health-related information on the local residents becomes available.

Because of the limited environmental sampling data available to both the ATSDR and the EPA, we recommend the following additional actions to protect the public health of area residents:

4. The responsible environmental regulatory agencies should within the calendar quarter, initiate data collection efforts to begin the characterization and determination of the extent of the radioactive contamination and possible presence of heavy metals. This sampling should include public water supplies and private wells in the area. Those wells exceeding standards should not be used for potable water and residents should be supplied with alternate potable water.

5. During this phase, personal radiation dosimeters and radon detection devices should be provided by the appropriate agencies to local residents to begin to estimate the external radiation exposure being received.

6. During these environmental studies and personal monitoring efforts, if the data being collected indicates that an imminent radiation health hazard exists to the area residents, then immediate steps, including consultation with the ATSDR, should be taken to mitigate that health hazard.

7. The mitigation or remediation would include, as appropriate, dissociation of local residents from the site until the direct public health hazard is removed. The remediation of the public health hazard should occur in the most expeditious manner consistent with Federal and State environmental protection, health, and radiation protection laws and regulations. Appropriate steps should be taken to protect public health during any removal actions (e.g., dust control, site access restrictions, and monitoring of radiation levels).

8. If these analyses indicate that the radiation exposures would result in a long term, chronic exposure, then applicable measures should be taken by the appropriate remedial regulatory agencies to remediate the public health hazard in the most expeditious manner and consistent with all applicable Federal, Tribal, and State guidelines and recommendations.

9. The appropriate agency should sample biota, food crops, and livestock to ascertain the potential for internal radiation exposure through consumption of contaminated food products and to identify addition potential sources of external exposure.

10. The appropriate responsible agency should take steps to prevent access to or otherwise make physically safe the various open mine areas, pits, and shafts.

11. Governmental agencies and any involved private sector organizations should work closely with Navajo representatives to ensure that cultural awareness and respect are observed and practiced.

For additional information, please contact the ATSDR at the following address:

Robert C. Williams, P.E.
Director, Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry
1600 Clifton Road, NE, MS E-32
Atlanta, Georgia 30333
(404) 639-0610
FTS 236-0610

REFERENCES

1. Molloy P. Preliminary Assessment for the Navajo-Brown Vandever Uranium Mine. Window Rock, AZ: The Navajo Nation. May 20, 1990.

2. Edison S. Preliminary Assessment for the Navajo-Desiderio Group Uranium Mines. Window Rock, AZ: The Navajo Nation. July 30, 1990.

3. U.S. Department of Health, Education and Welfare. Radiological Health Handbook. Washington, DC; 1970.

4. Eisenbud M. Environmental Radioactivity from Natural, Industrial, and Military Sources, 3rd ed. New York: Academic Press, Inc., 1987:475.

5. NCRP. Evaluation of Occupational and Environmental Exposures to Radon and Radon Daughters in the United States. NCRP Report 78. Bethesda: National Council on Radiation Protection and Measurements, 1984.

6. National Research Council. Health Risks of Radon and Other Internally Deposited Alpha-emitters. BEIR IV. Washington, D.C.: National Academy Press, 1988.

7. NCRP. Recommendations on Limits for Exposure to Ionizing Radiation. NCRP Report 91. Bethesda: National Council on Radiation Protection and Measurements, 1987.

8. National Research Council. Health Effects of Exposure to Low Levels of Ionizing Radiation. BEIR V. Washington, D.C.: National Academy Press, 1990.

APPENDIX B

Work Plan

Navajo Desiderio Group Uranium Mines

Work Plan

October 23, 1990

Introduction

This work plan summarizes the types of geochemical and georadiological surveying that will be employed by the EPA and its Technical Assistance Team (TAT) contractor at the Navajo Desiderio Group Uranium Mine Sites. Details of exact sampling locations and the number of samples to be collected will be determined on-site based on preliminary survey results.

Radiation Survey

The equipment used to perform the radiation surveys and measurements will include a micro R-meter and a survey ratemeter with the following probes: a sodium iodide (NaI) scintillation probe, a Geiger-Muller (G-M) pancake probe, and a zinc sulfide (ZnS) scintillation probe. The micro R-meter measures low-level gamma and X-rays in units of microRoentgens/hour. The various probes alter the detection and measurement capabilities of the ratemeter, which measures in counts per minute (cpm). The sodium iodide probe measures gamma rays, the Geiger-Muller probe measures alpha, beta and gamma radiation, and the zinc sulfide probe is specific for alpha particles.

All survey instruments will have been calibrated with National Institute of Standards and Technology (NIST)-traceable standards within the past six months. An operational check procedure will be performed on each instrument daily, in accordance with Ecology & Environment's Standard Operating Procedures (SOPs). Equipment will be operated according to the manufacturers' guidelines and recommendations, and will be operated by personnel properly trained in its operation and use.

Background Measurements

A minimum of two background measurements will be taken with each survey instrument to be used for site work. These measurements will be taken at least one mile from the site perimeter in an area representative of the local geology but unaffected by activities being studied at this project.

Initial Site Entry

During vehicle approach to the site and while driving around the site, the micro-R-meter will be used to measure radiation levels in ambient air. Upon exiting the vehicle, the micro-R-meter will remain on and a walkover radiation survey of the area will be performed. Support areas (as applicable) will be approved for setup if radiation levels are less than twice background.

Radiation Surveying and Sampling

Walkover radiation surveys will be performed using a survey ratemeter with a NaI probe. Average radiation levels over approximately a ten square meter area will be recorded. Discrete measurements will be taken at points of elevated readings ("hot spots") with the NaI, G-M, and ZnS probes.

Biased samples will be collected at hot spots. Radiation levels of sample material will be measured with the G-M probe and ZnS probe, as deemed appropriate. During all survey and sampling operations, radiation levels in ambient air will be monitored with the micro-R-meter.

Sampling Design

Because the Navajo Desiderio Group Uranium Site includes two abandoned uranium mines (Desiderio and Brown Vandever) that cover a large area, two schemes have been devised; one to handle areas immediately adjacent to residences and the other to sample the tailings piles themselves. A radiation survey will be conducted in both areas as outlined above. Sampling in a 250 feet radius of the homes will be at hot spots or at a reasonable percentage of grid points (5% to 10% of 25 feet grids). This will provide information about the material that is most easily carried into homes, either on the soles of shoes or via dust from vehicle traffic. Sampling on the tailings piles will be at the apex, at points midway between the apex and the bottom of the pile, and at the base of the pile. Both surface and depth samples (at 18 inches below the surface) will be taken to provide data concerning the weathering of the piles.

Soil Sampling Techniques

Surface samples will be taken with a spoon or trowel, whether they be of soil or tailings material. The depth samples of the tailings piles will be accessed through use of a hand auger. Radiation readings will be taken of the undisturbed soil at each sampling point and of the sample itself both before and after containerization. Close attention will be given to contamination control.

Groundwater Sampling

The drinking water wells used in the area will be sampled to determine the presence of radioactive material as well as heavy metal contamination. It is anticipated that this sampling will be done through household taps. The basic sampling technique is to allow the water to run through the cold water tap for at least three minutes to allow stagnant water in the pipes to clear before sampling. Water samples will be preserved with nitric acid to a pH <2.

Surface Water Sampling

In the event there is any surface water in the form of runoff or a stream in the area, it will also be sampled. In choosing a sampling location, special attention will be given to points accessible to area livestock. Samples will be collected directly into the sample jar from the stream or using dedicated syringes if the flow is too low to allow direct collection.

Air Sampling

Air samples will be collected on-site near residential properties using two to three high-volume air samplers. Samples (filters) will be analyzed for gross alpha and gross beta radiation. Prior to sampling, each unit will be calibrated in the field to a set flow rate (1.13 m^3/min - 40 cfm). The units will be positioned approximately six feet off the ground and operated over a 24-hour period. Filters will be removed as quickly as possible, folded lengthwise so that surfaces with collected particles are in contact, and catalogued in manila folders until sent to the lab for analysis.

Contamination Prevention and Waste Handling

After sealing the sample containers, each one will be tested to ensure that the outside of the jar is not contaminated. (This procedure also applies to sampling equipment.) The swipe test involves first measuring background radiation of an unused filter paper. The swipe samples are taken by smearing the clean filter paper over the surface of the sample jar. It is then counted using survey instruments to determine whether radionuclides are present on the outside of the container. If so, they will be decontaminated using dry methods or washed with a detergent solution (minimizing the use of water), allowed to dry, and recounted. The procedure will be repeated until no detectable radionuclides remain. The same type of procedure will be used to decontaminate the hand auger between samples.

Labelling and Transportation Requirements of Samples

All sample labelling and shipment will follow the requirements outlined in the DOT regulations in 40 CFR 171 - 177. Samples shipped via Federal Express will follow the parallel IATA regulations published in their Dangerous Goods Regulations.

Laboratory Selection

The two laboratories under consideration to perform both radiological and chemical analyses are TMA/Eberline of Albuquerque, New Mexico and Controls for Environmental Pollution (CEP) of Santa Fe, New Mexico.

Use of the XRF On-Site

The X-ray Fluorescence Spectrometer (XRF), a field portable instrument that detects metals in soils, will be used on-site as a screening instrument to locate optimum points for metals sampling. It will be programmed with a semi-site-specific model using arsenic, chromium, and vanadium as the target analytes. It will be used in a pattern that mimics that of the grid arranged for the radiation survey. The XRF requires multiple samplings at the same point to allow a statistically correct value. Therefore, at each sampling point, the samples will be analyzed three times for thirty seconds each run, yielding an average value for that point. High levels of any of the metals will warrant a physical sample; a number of the points will be sampled to confirm the accuracy of the XRF.

Physical Hazards

During radiation walk-through surveys any physical hazards encountered, such as open pits and vertical or horizontal mine shafts, will be marked off with stakes and hazard tape so that their locations are easily visible. These hazards will be evaluated to determine the need for remediation.

APPENDIX C

Data Validation Memorandum

MEMORANDUM

TO: William E. Lewis, DPO

FROM: Beverly Pester, TAT Chemist

DATE: March 18, 1991

RE: Metals Data Quality Assurance Review
Navajo Desiderio Group Uranium Site
TDD: T099011-102
PAN: E09Z019-AAA

This data quality assurance review encompasses 21 soil samples taken November 14-16, 1990. This particular data validation memorandum will address only the metals analyses performed on the samples.

Each sample was analyzed for the following suite of metals: chromium, vanadium, titanium, magnesium, manganese, barium, aluminum, molybdenum, arsenic, selenium, strontium, and lead. The analyses were performed by TMA Eberline Corporation, Albuquerque, New Mexico through their Monrovia, California facility.

The samples were numbered as follows:

- 1A through 21A

Data Qualifications

I. Holding Time: Acceptable

All samples were extracted and analyzed within the six-month holding time for metals analyses.

II. Initial and Continuing Calibration Verification:

Initial and continuing calibration verification were run with the appropriate frequency. Recovery limits (90%-110% of the mean value) were met in all cases except for magnesium. The initial calibration verification recovery was reported to be 112%. Thus, values for magnesium must be flagged as estimated (J).

III. Blanks: Acceptable

Blank samples were analyzed with the proper frequency (at least one for every twenty samples).

The soil preparation blank showed an aluminum concentration of 3.76 mg/L, which corresponds to a soil concentration of 376 mg/kg. Samples 4A and 20A, which have reported concentrations of aluminum less than five times the detection limit (1,880 mg/kg) must be flagged as undetected (U).

The soil preparation blank had a lead concentration of 0.35 mg/kg which raises the detection limit for lead to 1.75 mg/kg. Therefore, sample 4A must be flagged undetected (U).

The arsenic concentration in the final blank was 0.14 mg/kg, thus raising the detection limit for arsenic to 0.7 mg/kg. Samples 4A and 11A must be flagged undetected (U) for arsenic due to this correction for blank contamination.

Manganese contamination in the blank sample was 17 mg/kg; however, all samples had manganese concentrations greater than five times the revised detection limit of 85 mg/kg.

The concentration of titanium in the blank sample was 46 mg/kg which raises the detection limit for this analyte to 230 mg/kg. All soil samples must be flagged as undetected (U) for titanium.

IV. ICP Interference Check Sample:

All ICP interference check sample results were inside control limits with the exception of barium, which had a 25% recovery. This is due to the high concentration of calcium in the interference check sample and does not necessitate action.

V. Matrix Spike/Matrix Spike Duplicates: Acceptable

Sample 1A was used for matrix spike/matrix spike duplicate (MS/MSD) analysis. Each analyte in question was spiked. All spike recoveries were within control limits (+/- 25%) with the exception of selenium (MS/MSD = 30%/36%), strontium (MS/MSD = 250%/160%), and vanadium (MS/MSD = 49%/66%). In the case of vanadium, a high sample concentration in relation to spike level contributed to the low recovery. The low selenium recoveries are due to losses inherent in the extraction process. Strontium recovery limits have not been set by the laboratory.

The relative percent difference (RPD) of the MS/MSD pairs were all acceptable, with the exception of arsenic. The RPD for arsenic was 29%.

VI. Replicate Analyses: Acceptable

Replicate analysis was performed on Sample 1A. All relative percent differences (RPD) for detected analytes were acceptable, ranging from 1% to 25%

VI. Overall Assessment of Data

The assessment of this data is based on the information set forth in OSWER Directive 9360.4-01 "Quality Assurance/Quality Control Guidance for Removal Activities--Interim Final" (March 1990). The data is judged to be acceptable for all uses with the qualifiers noted above.

MEMORANDUM

TO: William E. Lewis, DPO

FROM: Beverly Pester, TAT Chemist

DATE: March 18, 1991

RE: Metals Data Quality Assurance Review
Navajo Desiderio Group Uranium Site
TDD: T099011-102
PAN: E09Z019-AAA

This data quality assurance review encompasses seven water samples taken November 14-16, 1990. This particular data validation memorandum will address only the metals analyses performed on the samples.

Each sample was analyzed for the following suite of metals: chromium, vanadium, titanium, magnesium, manganese, barium, aluminum, molybdenum, arsenic, selenium, strontium, and lead. The analyses were performed by TMA Eberline Corporation, Albuquerque, New Mexico through their Monrovia, California facility.

The samples were numbered as follows:

- W1 through W7

Data Qualifications

I. Holding Time: Acceptable

All samples were extracted and analyzed within the six-month holding time for metals analyses.

II. Initial and Continuing Calibration Verification:

Initial and continuing calibration verification were run with the appropriate frequency. Recovery limits (90%-110% of the mean value) were met in all cases except for magnesium. The initial calibration verification recovery was reported to be 132%. Thus, values for magnesium must be flagged as estimated (J).

The continuing calibration verification results were acceptable with the exception of selenium, which showed a recovery of 78%. However, no selenium was detected in any of the water samples.

III. Blanks: Acceptable

Blank samples were analyzed with the proper frequency (at least one for every twenty samples for each matrix).

The barium concentration in the blank sample was 0.0003 mg/L which necessitates an adjustment of the detection limit for barium to 0.0015 mg/L. All samples with barium concentrations reported are above this number.

The blank sample concentration of manganese was 0.0043 mg/L which alters the detection limit to five times that, or 0.022 mg/L. Consequently, sample W7 must be flagged as undetected (U).

Magnesium concentration in the blank sample was 1.1 mg/L, which raises the detection limit for that analyte to 5.5 mg/L. Samples W2, W3, W5, and W7 must be flagged as undetected (U) for magnesium.

The lead concentration in the blank sample was 0.0035 mg/L which raises the detection limit to 0.0175 mg/L. Consequently, samples W1, W2, W5, W6, and W7 must be flagged as undetected (U) for this analyte.

Arsenic in the blank sample was reported to be 0.0014 mg/L, thus raising the detection limit for arsenic to 0.007 mg/L. This necessitates flagging sample W1 as undetected (U) for arsenic.

IV. ICP Interference Check Sample: Acceptable

All ICP interference check sample results were inside control limits with the exception of barium, which had a 30% recovery. This is due to the high concentration of calcium in the interference check sample and does not necessitate action.

V. Matrix Spike/Matrix Spike Duplicates: Acceptable

Sample W1 was used for the matrix spike/matrix spike duplicate (MS/MSD) pair and was spiked with all analytes of interest. All spike recoveries were within control limits (+/- 25%) with the exception of magnesium, with a spike recovery of 55%. This requires no action, however, because the sample result was greater than ten times the spike. The relative percent difference (RPD) between the MS/MSD pairs were all below 5%.

VI. Replicate Analyses: Acceptable

Sample W1 was used for replicate analysis. For detected analytes, the relative percent differences (RPDs) range from 0% to

1.9%. For two analytes, aluminum and arsenic, one value was reported as not detected while the other was reported as a value. This makes RPD calculations on these two analytes inaccurate.

VI. Overall Assessment of Data

The assessment of this data is based on the information set forth in OSWER Directive 9360.4-01 "Quality Assurance/Quality Control Guidance for Removal Activities--Interim Final" (March 1990). The data is judged to be acceptable for all uses.

APPENDIX D

Photodocumentation

ECOLOGY & ENVIRONMENT, INC.
Technical Assistance Team

Navajo Desiderio Group Uranium Mines

PAN: E09Z019-SAA TDD: T099010-035

Photographer: Mary Sue Philp Date: 11/15/90

Photo 1: Open mine pit, Navajo-Brown Vandever site

Photo 2: Personnel decontamination monitoring

ECOLOGY & ENVIRONMENT, INC.
Technical Assistance Team

Navajo Desiderio Group Uranium Mines
PAN: E09Z019-SAA TDD: T099010-035
Photographer: Mary Sue Philp Date: 11/16/90

Photo 3: Navajo Desiderio site-Livestock Pond

Photo 4: Collection of radon cartridges

ECOLOGY & ENVIRONMENT, INC.
Technical Assistance Team

Navajo Desiderio Group Uranium Mines

PAN: E09Z019-SAA TDD: T099010-035

Photographer: Mary Sue Philp Date: 11/16/90

Photo 5: Preschool Well (Typical Livestock Well)